SEVENTY-FOURTH YEAR

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Three and a Half Years of Aerial Warfare

THIS war has made the airplane entirely practical. That simple statement means volumes for the advance made in aerial engineering, the aircraft industry, and the skill of the pilots.

No lesser authority than B. C. Hucks, the well-known British pilot, has compiled a series of figures bearing on the advance in aerial warfare during the period from June, 1914, to June, 1917, or approximately the first three years of the war. These figures have been used in order to make the graphic comparisons appearing on this page.

Taking first the numbers of certified pilots engaged in 1914 and in 1917, it is learned that they compare in the ratio of 1 to 5.75, or in relative size as shown. However, if these figures were represented by height without referring to bulk, a 5.5 foot man for 1914 would be 31.625 feet tall in 1917. These figures are presumably based on British aviation, but hold true within fairly narrow limits for those of all the warring powers.

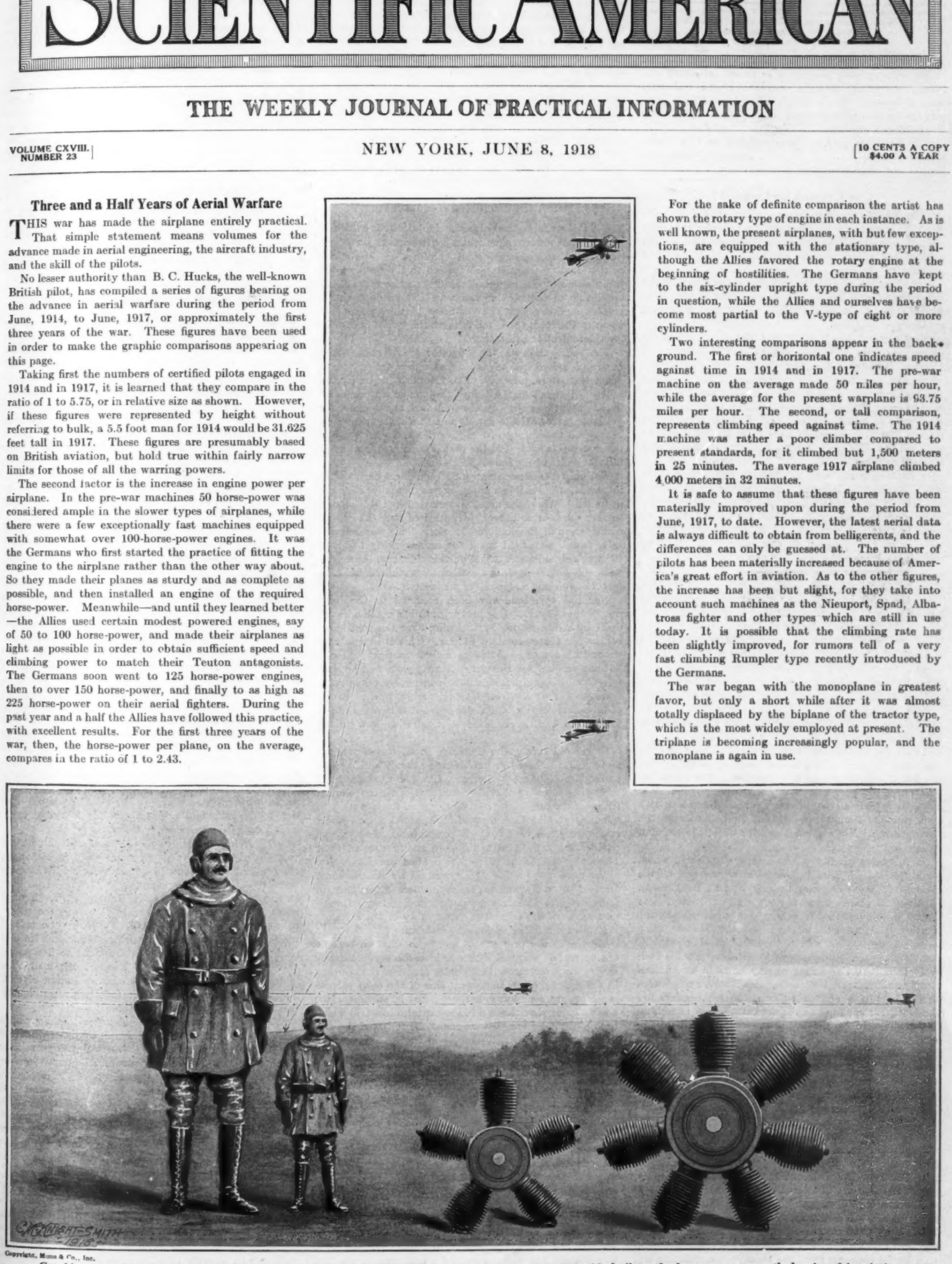
The second factor is the increase in engine power per airplane. In the pre-war machines 50 horse-power was considered ample in the slower types of airplanes, while there were a few exceptionally fast machines equipped with somewhat over 100-horse-power engines. It was the Germans who first started the practice of fitting the engine to the airplane rather than the other way about. So they made their planes as sturdy and as complete as possible, and then installed an engine of the required horse-power. Meanwhile—and until they learned better—the Allies used certain modest powered engines, say of 50 to 100 horse-power, and made their airplanes as light as possible in order to obtain sufficient speed and climbing power to match their Teuton antagonists. The Germans soon went to 125 horse-power engines, then to over 150 horse-power, and finally to as high as 225 horse-power on their aerial fighters. During the past year and a half the Allies have followed this practice, with excellent results. For the first three years of the war, then, the horse-power per plane, on the average, compares in the ratio of 1 to 2.43.

For the sake of definite comparison the artist has shown the rotary type of engine in each instance. As is well known, the present airplanes, with but few exceptions, are equipped with the stationary type, although the Allies favored the rotary engine at the beginning of hostilities. The Germans have kept to the six-cylinder upright type during the period in question, while the Allies and ourselves have become most partial to the V-type of eight or more cylinders.

Two interesting comparisons appear in the background. The first or horizontal one indicates speed against time in 1914 and in 1917. The pre-war machine on the average made 50 miles per hour, while the average for the present warplane is 93.75 miles per hour. The second, or tall comparison, represents climbing speed against time. The 1914 machine was rather a poor climber compared to present standards, for it climbed but 1,500 meters in 25 minutes. The average 1917 airplane climbed 4,000 meters in 32 minutes.

It is safe to assume that these figures have been materially improved upon during the period from June, 1917, to date. However, the latest aerial data is always difficult to obtain from belligerents, and the differences can only be guessed at. The number of pilots has been materially increased because of America's great effort in aviation. As to the other figures, the increase has been but slight, for they take into account such machines as the Nieuport, Spad, Albatross fighter and other types which are still in use today. It is possible that the climbing rate has been slightly improved, for rumors tell of a very fast climbing Rumpler type recently introduced by the Germans.

The war began with the monoplane in greatest favor, but only a short while after it was almost totally displaced by the biplane of the tractor type, which is the most widely employed at present. The triplane is becoming increasingly popular, and the monoplane is again in use.



Graphic comparison of aviation in June, 1914, and June, 1917, showing the increase in number of certified pilots, the horse-power growth developed by airplane engines, the flying speed against time, and the climbing speed against time

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Can England Be Invaded?

ONE of the methods used by pro-German influences in the attempt to provoke prejudice against Great Britain, is to suggest that a large part of her military forces are being held in England because of the fear of German invasion; the object being, of course, to put the thought in the minds of the Allies that Great Britain is acting selfishly in not giving as full coöperation as she might to the armies fighting on the western front.

Now, any one who is conversant with naval operations knows perfectly well how absurd is this bugaboo of German invasion. The German General Staff never allow any operation to be undertaken unless they feel reasonably certain of its success; and they are well aware that to carry through a serious invasion, resulting in the conquest and occupancy of Great Britain, a minimum force of 250,000 men would have to be landed, together with all the field and heavy artillery, transport and military supplies.

In contemplating such an invasion one of two plans would have to be followed: The only safe and certain plan would be to obtain command of the sea, either by destroying the enemy fleets, or blockading them so securely that any sortie would be impossible. If this were done, the question of communications would be solved; and, once the invading army had been landed, it would be possible to keep it fully and continuously supplied.

On the other hand, if the General Staff believed the British navy to be so powerful that its command of the seas could never be seriously challenged, then the only other possible way to get an army of 250,000 men landed in England would be to secretly gather a fleet of transports in the German ports, make a rush across the North Sea, and achieve a surprise landing at two or three points on the east coast within supporting distance of each other.

Now, the probability of Germany's ever obtaining the absolute command of the sea, even for a limited period, is extremely remote. She tried it at Jutland, when she had only the British fleet against her, and she liked her "glorious victory" as the Kaiser called it, so little, that she has never sought to gain another. But when we sent our destroyers and battleships over to add their strength to that of the British navy all discussion, nay even the very thought, of winning the command of the sea must have died out once and for all at the German Admiralty.

As to the possibility of making a surprise invasion, while the British were in command of the sea, all the chances of the thing are heavily against its success. In the first place, there is not in all the Seven Seas a stretch of water that is so thoroughly patrolled as the North Sea. Patrol boats, big and little, trawlers, mine sweepers, destroyers, and a thousand passing ships of commerce, each equipped with wireless, would flash early tidings of the sailing of any Armada to Admiral Beatty. Moreover, long before the German ships were sighted by surface craft, the throb of their propellers and the loom of their bulk in the darkness would have been heard and seen by the far-flung screen of British submarines. Should the fleet steam out from Wilhelmshaven and the mouth of the Elbe, how would it pass through the vast mine field covering the German coast, which is shown in the map which we publish on another page of this issue.

However, let us suppose that German mine sweepers should manage to open clear water for the transport fleet out into the North Sea. What then? What would be the chances of this fleet covering the 350 miles of distance to the coast of England and disembarking 250,000 men with their artillery and military supplies, before the British fleet came up and sank every one of the transports? Let us take it for granted that if an army of 250,000 Germans, thoroughly equipped, could be landed on the east coast, such an army could live off the land and make good its losses in guns, and ammunition by its captures from the enemy; the question still has to be answered by what miracle of good luck could such a large fleet make the passage and the landing without being discovered.

A brief consideration shows that it would require a veritable Armada to transport a thoroughly equipped army of this size. Our own Quartermaster Department estimates that for conveying our troops in France we require five tons of shipping to the man. Let us cut that figure in half for the North Sea passage, and we still find that 625,000 tons of shipping would be required, which, at an average of say 6,000 tons to the ship, would call for a fleet of 104 transports.

No, the British are not holding troops in England because of any fear of invasion by Germany. Of the several millions that she has called to colors, only a certain proportion can be counted as fighting men that will carry a rifle at the front; and of these, possibly a million are under the sod in France or have been permanently crippled in their fight for the common cause. The others are still undergoing their training ready for the front, or are fighting in France, in Italy, in Greece, or in far distant Palestine and Mesopotamia.

An Unrecognized Resource

THE world scarcely realizes the extent to which it is dependent upon the scientist and engineer for the conveniences and comforts of life. And as the ideas of scientists are applied to the problems of peaceful life by the engineer, so must he also make them applicable to the problems of war. Thus the engineer creates and develops the resources of war, transports them to the front, and builds there the works necessary for their effective utilization.

The segregation of the engineer gained but slight headway before his advent as a college trained man. Even then it required years to establish his entity, so much is he part of the things that make up our daily lives. But this entity once established, the demand for graduates exceeded the supply; and with war increasing many-fold the output of our factories and straining our transportation system to the breaking point, the number falls far short of the barest necessities.

Not only has the demand for the engineer been vastly increased, the visible supply seems actually to have dwindled. When the great war started in 1914, among the very first to volunteer their services were the college trained men of England and France. This was natural; their training enabled them the more quickly to grasp the war's significance. And on this side, too, those who were able have gone into the fighting machine itself, still further depleting the ranks of engineers.

Nor has this tendency been confined to the fully qualified engineers. Our hasty youth has made a heavy draft upon the future by throwing over the routine of college for the excitement of war. This is in one way good; but a man who leaves college to fight will not become an engineer this year, or next year, and he is in fair way of being permanently diverted, by casualty or transfer of interests, from his engineering career. Much of this diversion we cannot afford; so it is in order for us to take stock of the situation, to inquire just how serious it is.

In general terms, the tendency in all quarters is for more men to enter our engineering schools and for less to remain. The very shortage, the many openings for men who have completed even a part of their technical training, the publicity given to the need for engineers to win the war, all attract men into the paths leading toward engineering. Accordingly it is natural that many engineering schools should report an increase in their Freshman classes for 1917-18 as against previous years.

We must not be unduly encouraged by this showing. In at least one large university, where attendance in representative elementary courses preliminary to engineering work has increased, the quality of the students has fallen off. The increased attendance, it seems, has been due to the presence of men who want to become engineers, but who will sooner or later discover that they never can; for more than determination is necessary in the making of an engineer. One of the most earnest aspirants we ever knew, barely passed in trigonometry; and realizing that this is a fundamental subject, in which he could not be too well grounded, he repeated it—and flunked it! Only the instructor in engineering subjects realizes what a large percentage of the normal attendance is of this small caliber; and such a man will appreciate that increased attendance means little until it has passed the point where the Sophomore class is subjected to its first weeding out.

On the other hand, decreased attendance in the classes where it is reasonably certain that the incompetents have been eliminated is a matter of real concern. Massachusetts Institute of Technology reports this year's three upper classes as 93, 75 and 86 per cent, respectively, of normal; the Dean of the Michigan University Engineering College estimates a decline in engineering student bodies throughout the country of from 25 to 35 per cent. There seems to be the greatest shrinkage among the Juniors, last year's Sophomores, to whom two years more of schooling has perhaps seemed a long time in the face of striking events that appear to call for a display of patriotism. Then, too, the average age of engineering graduates is 23; so most of the men in the two upper classes are in the draft, and few indeed have deferred classification.

There are a good many things that can be done, if not to cure this trouble, at least to alleviate it. The graduation of classes a year ahead of time, by intensive study and use of vacation time, has its attractive features; it aims directly at the existing shortage. But again it borrows from the future; this we must do in wartime to some extent, but never without realizing clearly that we are doing it, never without asking whether the debt is one which should be assumed and can be discharged. The establishment in the colleges of bodies like the Engineering Enlisted Reserve Corps and the Naval Reserve Force will doubtless keep a good many men in these classes who would otherwise leave. Sooner or later the Government will recognize attendance at technical schools as ground per se for deferred classification—not with any idea of robbing the army, but rather in order to supply the army with the men it needs. That is the whole problem—to make the students themselves and those who have control over them in and out of college appreciate that an engineer next year or the year after amounts to far more than a private or even a line officer this year. We must conserve every resource; and a high place among our resources is held by the body of young men who are on the way to become engineers.

The Need of a Dietary Revolution

PROBABLY eveybody has thought more or less vaguely of the effects which prejudice, custom and ignorance exercise upon the food supply of mankind. We often look about us at the innumerable species of plants and animals which supply nothing to out tables and speculate upon their dietary possibilities. We reflect upon the paradox of certain foods which are esteemed delicacies in one country and rejected with disgust in another.

At a time when it is becoming a difficult problem to get enough of the foods by which we are accustomed to supply our bodily needs, it is high time to consider whether radical changes in our diet might not furnish a satisfactory solution of this problem. It is time to take stock of our knowledge and crystallize our ideas on this subject. Perhaps no more signal service could be rendered to the nation by the Food Administration or the Department of Agriculture than to inaugurate sweeping reforms in the national menu. The expedient of this-less and that-less days is only a half-measure, and the less important half. A more urgent need is additions to the weekly bill-of-fare rather than subtractions from it.

In a recent address before the Franklin Institute, Dr. David Fairchild, of the U. S. Office of Foreign Seed and Plant Introduction, turned the searchlight of his expert knowledge upon this momentous question. He said: "It seems to me that the present era is one of tremendous change and immense possibilities in these matters of food, and that the time is at hand when a full discussion of taste in foods is opportune. The war is rapidly changing the trade routes of the world, and the Oriental tropics are brought closer to us than ever before by the lines of direct steamers through the Panama Canal. We have the spectacle of hundreds of millions of people studying as they never did before the food supply of the whole world with reference to their particular contribution to it as a world problem, not, as in former years, largely as a local question."

Dr. Fairchild traces in a most illuminating manner the vagaries of the human palate as a factor in economics. He recalls the startling fact that starving Belgium refused to eat corn, while even the English and Irish have had to be cajoled and deceived into eating it. Equally remarkable is the indifference of the American people to rice, which forms the staff of life for hundreds of millions of human beings in other countries. He tells us how the Japanese raise oats to feed to horses and cattle, but have not learned to eat oatmeal; a situation which reminds us of Dr. Johnson's definition of oats, "a grain which in England is generally given to horses, but in Scotland supports the people."

We have not space for a summary of Dr. Fairchild's interesting address, "The Palate of Civilized Man and Its Influence on Agriculture," but we wish to register the hope that it will serve as the starting point in a far more comprehensive campaign of dietary reforms than any that our Government or any other has hitherto undertaken. There are, indeed, many tokens that such a campaign is already well launched. Apart from the manifold enterprises of the Government in improving and diversifying agriculture, we have lately witnessed almost spectacular activity on the part of the Bureau of Fisheries in developing sources of aquatic foods.

Necessity is going to prove the mother of invention. We must try all things and hold fast to that which is good among the actual and potential foods within our reach. Nature is bountiful beyond all belief in the foods she provides for us. How long are we going to permit custom and caprice to prevent us from accepting her bounties?

Naval and Military

Spruce for Airplanes.—It was recently announced in Washington that 30,000,000 of the 60,000,000 feet of spruce timber required for the construction of airplanes this year, has been cut; and that the total amount required would be delivered to the Government airplane building plants before July 1st.

Work of British Transports.—The British mercantile marine, up to the close of last year, had transported overseas under the guardianship of the British Navy, a total of 13,000,000 troops; and in the course of this vast operation the loss of life, due to enemy action, was only 2,700 men. In addition to these troops, 25,000,000 tons of supplies had also been transported overseas. Here is one rather conclusive answer to the cuckoo cry of the German propagandist: "Where is the British Fleet?"

Brazil in the War.—Because not much has been heard about Brazil's share in the war, it must not be presumed that she is doing little or nothing. As a matter of fact, conscription is in force and every possible preparation is being made to strike a heavy blow in Europe. Brazil's ships are patrolling the coast of South America and other ships have gone to European waters, where they are operating with the Allied navies. The Brazilian navy includes several dreadnaughts of good speed and heavy offensive power.

Meteorology on the Western Front.—People who believe that positively every success of the Germans is due to prevision and provision and not any of it to luck, are telling us that German meteorologists have made a very close four-year study of weather conditions in France and Belgium, with the result that they are able to predict forthcoming weather with true Teutonic precision. The phenomenally fine weather which favored the Germans in the recent great drive, and turned the marshy valleys of the Somme and of the Oise into dry land with good going for the German artillery, may have been predicted and the drive started accordingly.

The French Silence 75-Mile Guns.—The fact that there was a long intermission in the bombardment of Paris by the 75-mile guns would seem to establish the claim of the French gunners that they succeeded in putting these guns out of commission. If so, the feat was probably accomplished by some of the heaviest long-range artillery of the French directed by aerial observation. If the 15- or 20-inch French gun was used, it would not need a direct hit on the gun itself to put the piece out of commission; one of these shells, landing on the concrete emplacement, would have sufficient explosive energy to overturn both gun and mount.

Total Immobilization of the German Fleet.—So completely has public attention been drawn to the terrific fighting on the western front, that the public has lost sight of the contending navies upon which the success or failure of the whole war depends. If the German High Seas Fleet were to steam forth and crush the Allied fleets, or even the British fleet alone, she could deal in a single day that fatal blow against the British Empire which she has failed to get home with her army in the four years of war. The battleship fleet at Kiel and Wilhelmshaven, the second in power in the world, remains year after year hopelessly shut up at its bases. No greater demonstration of the value of the command of the sea has ever been witnessed than this.

Failure of the U-Boats.—Just before the Germans started their submarine campaign, the German Admiralty boasted that 1,000,000 tons of shipping would be sunk every month. They had the date for the final wiping out of the British mercantile marine and the collapse of the British Empire figured out almost to the month. They started off with a total sinkings of over 890,000 tons for April, and thereafter there was a slow but steady decline in losses. During last winter they sank an average of 400,000 tons of shipping per month; but the shrinkage in losses still proceeds, and during April of this year only 220,709 tons of British and 84,393 tons of neutral and allied shipping were sunk—making a total of 305,102 tons. To complete the picture there comes the blocking of Ostend and Zeebrugge and the closing of the North Sea by a mine field.

Building a Ship in Twenty seven Days.—The astonishing record achieved by the New York Shipbuilding Company in launching a ship in 27 days from the laying of her keel, is bound to have a stimulating effect upon our new shipbuilding program in more ways than one. The most important lesson taught by this achievement is the enormous increase in the capacity of our yards which would result from the introduction of three 8-hour shifts. It was this, of course, that rendered possible the quick work done by the New York shipyard. We understand that there is some objection on the part of labor to the introduction of the three-shift plan, but we believe that the same appeal to common sense and patriotism, which resulted in bringing in the new men required by the yards, would succeed in introducing at least a ten-hour shift among the majority of yards throughout the country. The resulting speeding-up of shipbuilding would be enormous.

Astronomy

Stellar Parallaxes.—The rapid progress that has been made in determinations of stellar parallex is indicated by the fact that while up to the year 1910 the number of stars of accurately known parallax was 365, the number is now about 800. According to a recent paper by Adriaan van Maanen, the size of the probable errors in these determinations has considerably decreased with the increase in the focal length of the instruments employed. For most of the larger observatories it is now smaller than 0.01 second, with 45 exposures or less, and in the Mount Wilson parallaxes, where the focal length is 80 feet, it is even smaller than 0.006 second, with 16 exposures.

Naval Observatory Time Signals.—The last annual report of the U. S. Naval Observatory states that the accuracy of the radio time signals sent out from the observatory via the wireless station at Radio (Arlington), Va., has made possible the rating of chronometers anywhere in the North Atlantic Ocean so satisfactorily that the Navy has reduced to one the allowance of chronometers for vessels operating along the Atlantic coast. This is a matter of special importance at the present time, when good chronometers are much harder to obtain than in times of peace. The mean daily error of signals sent from the observatory last year was 0.036 second, with a maximum error of 0.21 second. Error is caused by a change in rate of the standard clock during cloudy periods, when observations of stars for time is impossible. The outbreak of the war led to the dismantling of privately owned wireless receiving sets all over the country. The number of requests for exemption which have come to the Navy Department from watch manufacturers, jewelers, scientific laboratories and observatories shows how widespread has been the custom of receiving the official time signals by wireless.

Absolute Magnitude.—This convenient expression of the intrinsic brightness of a star has recently come into use. The absolute magnitude of a star is the brightness, on the Harvard scale of magnitudes, that it would have if its distance were such as to give it an annual parallax of 0.1 second of arc. Thus Alpha Centauri, as we see it in the sky, is of the 0.2 magnitude, but it is the nearest known star, and has a parallax of 0.75 second. If it were removed to 7.5 times its present distance, so that its parallax would be only 0.1 second, it would appear as a star of magnitude 4.6. This is its absolute magnitude. Near Alpha Centauri is a faint star, recently discovered to have about the same parallax. Its apparent magnitude is 11, but in absolute magnitude it is by far the faintest star yet discovered. Sirius, the brightest star in the sky, with an apparent magnitude of —1.6, has an absolute magnitude of 1.3. According to recent investigations by Adams and Strömberg, the radial velocity of a star (*i. e.*, its speed of motion in the line of sight from our system to the star) is a function of the absolute magnitude. The velocity increases about 1.5 kilometers per second for a decrease in absolute brightness of one magnitude. This remarkable discovery, if confirmed, would point to a difference in the action of gravitation upon matter in different stages of temperature and condensation.

Star Positions and the Weather Map.—An interesting suggestion is made by Mr. W. A. Conrad, of the Naval Observatory, as to the probable effects of a strong horizontal barometric gradient upon determinations of star places, and incidentally upon the rating of a standard clock by observations of "clock stars." The standard clock system at the observatory consists of three Riefler sidereal clocks mounted in airtight cases in the constant temperature vault. It has been noticed that sudden jumps in the rates of all three clocks, as determined by the regular star observations, occasionally occur at the same time and that they are alike in amount and direction. In view of the perfect installation of the clocks these jumps apparently cannot be due to local temperature or pressure changes. It has been found that the jumps have occurred during the passage of "cold waves." At the time of the jump a marked low-pressure area is receding to the eastward, and a marked "high" is coming in from the west. This means a strong tilting of the isobaric surfaces, and the observations of the clock stars would undergo abnormal lateral refraction; clocks rated by such observations would therefore show a fluctuation of rate that did not really exist. Mr. Conrad finds that, by applying this hypothesis, he is able to forecast roughly the occurrence of these eccentricities in the standard clocks from the daily weather map. This matter is of practical interest, since the official time of the country is derived from the standard clocks in question; moreover, the conclusion that lateral refraction enters into all fundamental star place work to a certain extent, in both right ascension and declination, seems plausible. The observer with the transit circle, zenith tube or prime vertical, who finds that a whole night's observations stand out widely from the mean of the entire work for no obvious reason, may discover that the weather map furnishes the explanation.

Engineering

Electrically-Welded Ships. In place of using rivets to fasten the plates and the framing of a ship together, a test is being made by the Emergency Fleet Corporation, at the Federal Shipbuilding Company's yard in Kearney, N. J., in the use of electric welding. This test is to be conducted on a 40-foot length of a 9,600-ton cargo steamship. Both spot welding and continuous arc welding will be used, the spot welding for connecting the frames and plates, and the arc welding for joining the seams of the plates. The hull to be tested will be filled with water and subjected to various strains in order to judge of the strength of the joints. Should the test prove successful, it will result not only in the saving of 10 per cent of weight, but also in a great economy of time. It will eliminate a great deal of work in marking out-punching, and fitting of the members, as well as a reduction in the railroad transportation from the rolling mill to the fabricating plant. It is believed that the total saving will amount to about $40 per ton of the steel structure.

Testing Concrete Ship at Sea.—Exhaustive tests of the concrete ship "Faith" under actual seagoing conditions have been ordered by R. J. Wig, chief engineer of the department of concrete-ship construction of the Shipping Board. It was announced at the Shipping Board, several weeks ago, that a committee of experts would leave for California, to accompany the "Faith" on her trial trip. The committee consists of F. R. McMillin and H. S. Loeffler, engineers, and L. Brush, naval architect. Self-recording instruments of new design will be used to determine the nature and effect of strain on the steel reinforcements and the results of wave pressure. The tests are expected to provide ample data necessary for expediting the designs now under preparation for the Government's fleet of concrete tankers. A report by Chief Engineer Wig on the development of concrete-ship construction abroad lists the following British and French programs already in advanced stages of production; England, 140 barges of 1,000 tons each and 24 tugboats; France, 700 barges of 1,000 tons each and 50 tugboats.

Effect of Temperature On Strength of Iron and Steel.—An interesting series of tests and a collation of the results of existing tests in this direction have recently been made by a manufacturer of soot cleaners, which are peculiarly liable to severe tensile and elastic stresses while heated to a high temperature. It is found that as a general rule the strengths and yield points of steel and of cast or wrought iron increase with the temperature up to a certain point, beyond which they fall more rapidly than they climbed. Thus the greatest ultimate strength in wrought iron is found at 450 degrees F., and its maximum elastic limit at 350 degrees. With steel the ultimate elastic strength increases up to 575 degrees, while the elastic limit forms an exception to the general rule, in that it decreases continuously, though not uniformly, as the temperature rises above the normal of 60 degrees. In fact, at 1,000 degrees the elastic limit vanishes entirely, and steel will then sag of its own weight. With cast iron both the rise to maximum tensile strength at about 400 degrees and the fall beyond that point are much more gradual—so much so, in fact, that the maximum point cannot be accurately estimated from the graph.

Freight on the Road Versus Freight at the Terminals.—As an example of the relative cost of distributing commodities the following tables based on figures given a couple of years ago by a late vice-president of the New York Central Railroad are interesting:

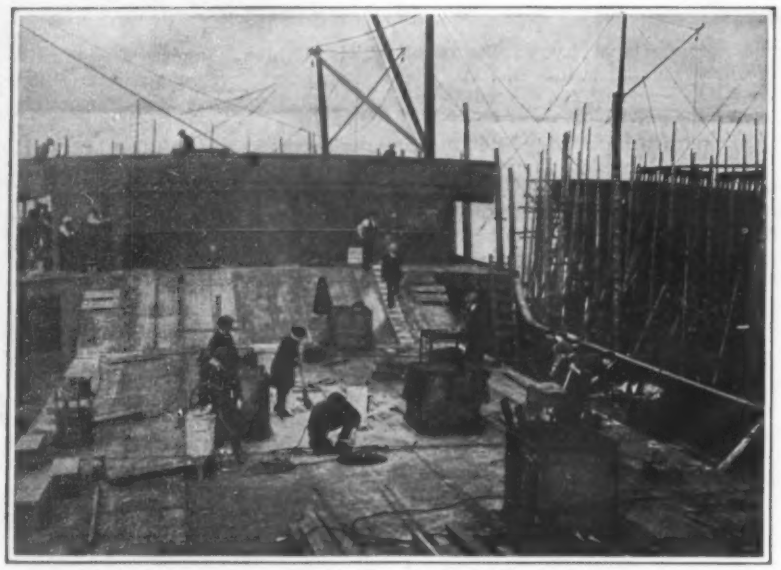
A manufacturer in Philadelphia sends one ton of freight to a merchant in New York city, and from the time the freight leaves the manufacturer, the Philadelphia charges are, or were, as follows:

Labor cost of loading on a wagon	$0.25
Unloading at freight station	.50
Cost to railroad in billing and other clerical work	.40
Actual operating expense of loading and switching freight car, etc.	.25
	$1.40

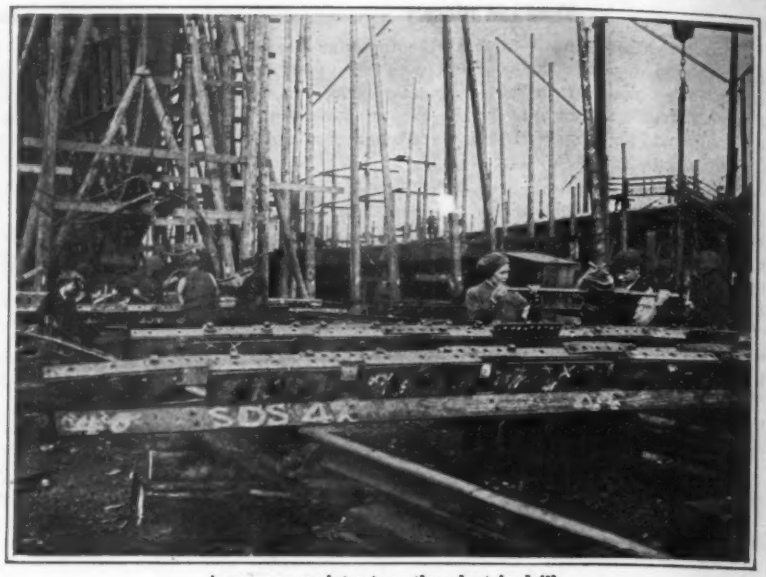
The cost of handling in New York is as follows:

Terminal costs on New Jersey side of North River (average of all railroads)	$0.15
Lighterage	.80
Terminal cost on water front of Manhattan Island	.50
Cartage expenses in New York City	.80
	$2.25

The terminal charges at both ends equal a total of $3.65 on one ton of freight. It costs the railway to haul freight three mills per ton per mile, or for the 90 miles between Philadelphia and New York, 27 cents per ton. The cost of getting a ton of freight started on its journey on one end and handling it from the Jersey City terminal to the consignee's store at the other end is nearly fourteen times as much as the cost to haul the goods all the way from Philadelphia to New York. Very evidently, there is an opportunity for some real efficiency work in cutting down the expense of freight handling and city delivery.



Women shipyard employes working at deck construction



A woman assistant on the electric drill

Where England Gets Her Women Workers

The Factory School Which Promises to Supply the Skilled Labor of the Future

OUR manufacturers complain, with reason, that they cannot find enough skilled or semi-skilled men. Now a business man, when he takes raw material into his factory and makes it over into the finished product, does not feel that he is wasting his own time or that of his employees in working on it, in shaping it and changing it, in making it valuable for his use. It would seem that we can afford to do as well by our men as we do by our materials. We must do this, in fact; for unless we adopt steps looking toward the permanent improvement of the conditions that bother us today, they will be with us year after year.

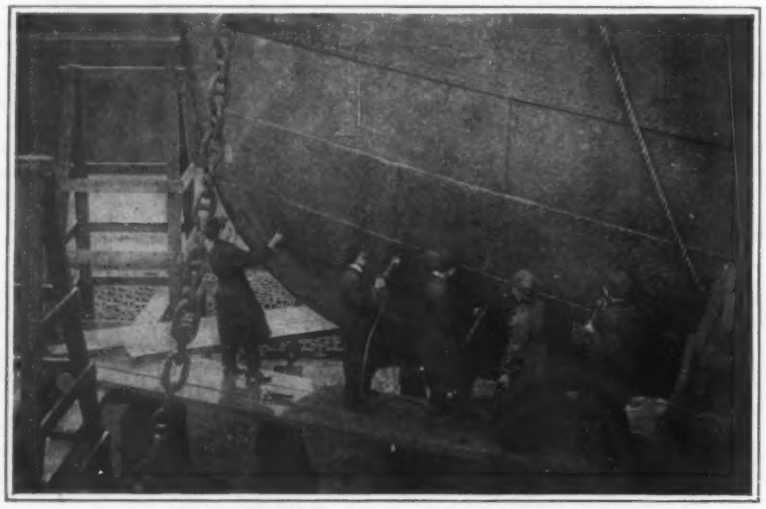
A worker cannot become a machinist until he has access to a machine, with information as to its use. Manufacturers do not leave to accident or voluntary action of the producer their supplies of fuel or materials; isn't it about time to stop the haphazard method in regard to labor supply? The man who sits in the center of his little web, waiting for labor to fall in, will in the long run fare worse than the man who goes out after men, gets them where he can, and then molds them intelligently to his needs.

Under the old dispensation a man applies at a factory, claiming that he can do a certain thing. After a few hours or days it is discovered that he can do it poorly or not at all. Sometimes a degree of effort is made to find something he can do; otherwise, or in the failure of such effort, out he goes—and another employer wastes time and money in discovering the nature of his inefficiency.

It would seem that our manufacturers might take a leaf out of the Government's book without having it rammed down their throats, if we may mix our metaphors a bit. Uncle Sam needs several million fighters, and he needs them as fast as he can get them. Does he comb over his population, looking for a couple of million men who think they can fight, trying them out for a day or two, and attaching the order of the can to those who turn out not to know how to fight? He does not; if he did, we could easily look forward to the day when the western front would move over to the western coast of France, and stay there.

What Uncle Sam does in the emergency confronting him is to gather in a few millions of his boys whose physical equipment is such that he may be sure they can be taught to fight. Then—he teaches them. As far as is advisable, he does this by means of actual experience with fighters, on the fighting front. He runs his fighting school in collaboration with his regular fighting equipment. But he does not permit this collaboration to become so close that the business of fighting interferes with that of instruction, or vice versa.

This eminently sensible procedure is strongly indicated for industrial use as a means of meeting the shortage of labor caused by the war. Nor is the manufacturer who adopts it called upon to break virgin ground. The thing has been done industrially, following very closely the lines indicated by army experience. Just as in the army, the recruits are isolated from the regulars for the first part of their training, and gradually worked into the actual service. For here, too, the serious work of the plant, which is production, must not be hampered by immediate physical contact with a group of raw workers. Moreover, the regular foreman in charge of production has not the necessary time to give to the breaking in of green help, or of help that has obtained but a partial training in the shops. Accordingly it is essential, in going into this business of training workers, to have a separate training department to which all beginners may be sent and there remain long enough to learn the rudiments of shop practice.



English women chipping and scaling ship's bottom in dry dock

The selection of a teacher calls for good judgment; for not everybody has the faculty to teach. The best worker is seldom a good teacher; teaching requires not merely ability to do, but ability to analyze the way of doing, and to impart the information thus gained to another. Sometimes a fine teacher will be discovered among the productive force; sometimes a teacher will be engaged from outside; but in any event the success of the undertaking depends largely upon this selection.

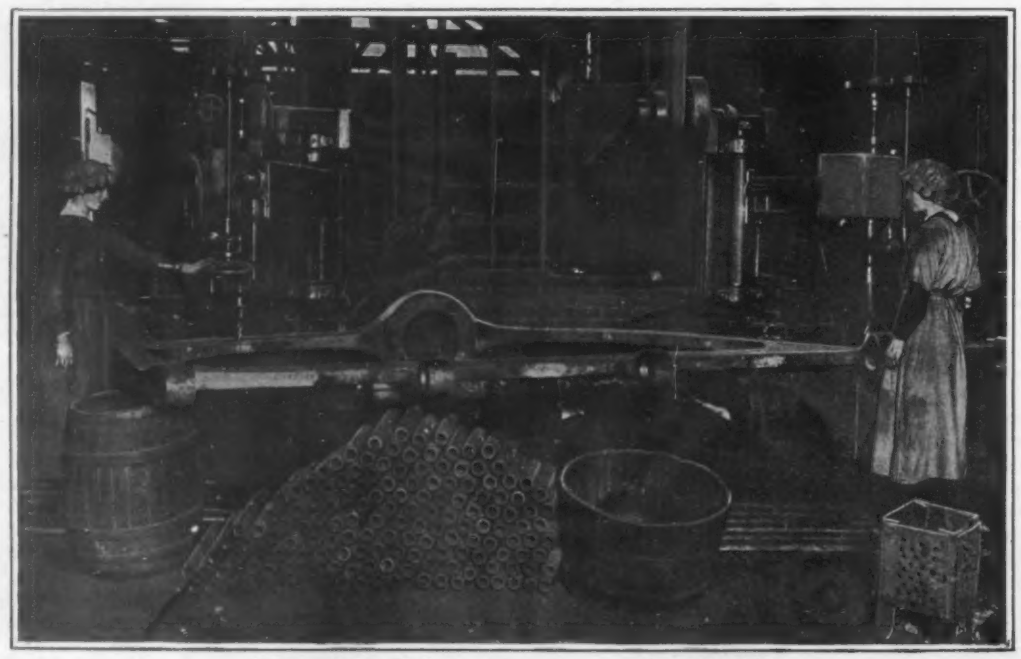
When the instructor is installed, the game is to let each of the raw workers have a few hours training each day, and to give him for the balance of the day such manual work as he can do, so that he can earn a moderate day's pay while learning something better. Much of the so-called skill that is lacking in workers can and will be acquired in a few days. That the whole scheme is eminently practicable is established beyond doubt by the experience of many concerns that have given it a more or less grudging trial. We may quote from the superintendent of a Worcester, Mass., factory:

"We have in training 33 men and boys, using lathes, vertical and horizontal milling machines, grinders, shapers, drills, arbor presses, and other machinery. The training department is separate from the rest of the plant, with its own equipment. We do not pretend to turn out, by means of this department, skilled machinists, although in the cases of those who have shown a natural gift for mechanics it has been a revelation to see with what rapidity they learned.

"We have put through this school since its inception 270 people. We are now putting them through at the rate of about five per week. We have retained 90 in our employ to date; other Worcester firms have hired 180 away from us. This is an indication that the product of our school is worth bidding for.

"Several of our boys who had a total of not over four months' training have been accepted by the Navy as second-class machinists. Our foreman of toolmakers on the night shift is a product of the school and one of the best toolmakers we have. He had had no machine experience whatever. We have had a number of men who,

(Concluded on page 532)



Women drilling holes in a stern-frame on the radial drill

The Advantages and Increasing Use of Pulverized Coal

A Form of Fuel Whose Present Annual Consumption is 10,000 Tons

THE inherent economic advantages of the use of pulverized coal are such as to make certain its employment on an ever-increasing scale and in an ever-widening field. It is not generally understood to what an extent coal is now being burned in the pulverized form; but in a report prepared by the Fuel and Fuel Handling Committee of the Naval Consulting Board made to the President of the United States Shipping Board it is estimated that 50,000,000 tons of coal have been pulverized and consumed within recent years in the United States. Another estimate places the present annual consumption at 10,000,000 tons.

The first successful application of pulverized coal was in the Portland cement industry, which has stimulated the development and use of this fuel for the reason that pulverizing machinery was brought to its present high state of development in the Portland cement industry. In making cement, not only is the coal pulverized, but for each 380-pound barrel of cement there are required about 600 pounds of raw material as well as the 380 pounds of clinker produced by the kilns; so that altogether 1,100 pounds of raw material, clinker and coal, must be ground to produce one barrel of Portland cement.

In the preparing and handling of pulverized coal, the coal is received as slack, lump or run of mine, and it has to be crushed so that it will pass through a one-inch ring. The coal is dried to eliminate all but about one per cent of the moisture. The drier is generally of the rotary type through which the coal passes by gravity.

It is necessary to remove all metal particles from the coal as delivered at the plant. These particles consist of railroad spikes, coupling pins, hammer heads, nails, etc., which may have accumulated either at the mines or in the crushing machinery. This is done satisfactorily by means of a magnetic separator.

It should be understood that merely powdering the coal is not sufficient; it must be pulverized so that at least 95 per cent of it will pass through a 100-mesh sieve having 10,000 openings to the square inch—which means that 95 per cent of the product must measure less than 1-200 of an inch cube. The finer the coal is pulverized the more readily will it be diffused when it is mixed with the air necessary for combustion when it is fed into the furnaces. A cubic inch of coal has a superficial area of six square inches, and a simple calculation will show that when the cube of coal has been ground the superficial area will increase to nearly 30 square feet—an increase in area of approximately 700 times. The importance of this increase of area in producing perfect and instantaneous combustion is self-evident.

It is estimated that the consumption of pulverized coal today in the manufacture of cement, the iron and steel industry, in the production of copper, and for power purposes is about as follows:

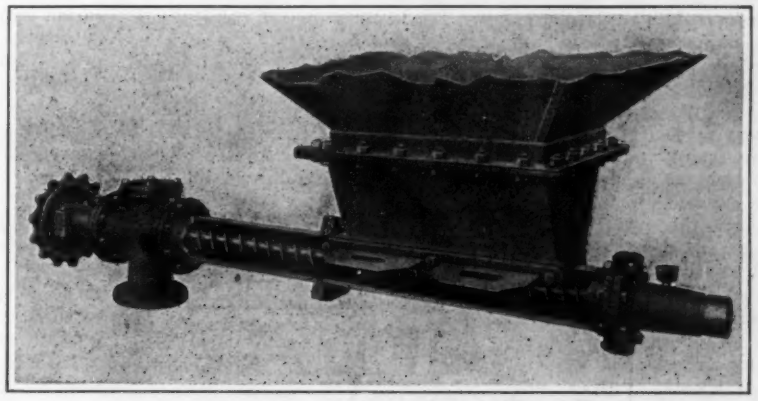
- In the manufacture of cement, 6,000,000 tons.
- In the iron and steel industry, 2,000,000 tons.
- In the production of copper, 1,500,000 tons; and
- In the generation of power about 200,000 tons.

From the above tabulation, it will be evident that although some development work will be necessary for its application to new industries and operations, pulverized coal has passed well beyond the experimental stage.

Some of the obvious advantages of the use of this fuel are that its feed can be regulated as easily as that of oil or gas; that it is possible absolutely to control the intensity of its combustion; that any kind of flame can be obtained, either oxidizing or reducing. It is important to remember that it acts more or less like a gas when it is fed to furnaces, and therefore the latter should be designed to burn a gaseous mixture. Other advantages of this form of fuel are:

Pulverized coal produces no clinkers; it is smokeless; a lower percentage of excess air can be utilized; all the combustible in the coal is consumed; its flexibility of operation permits quick adjustment to underload or overload; the fuel supply can be instantly shut off in case of accident; a saving of 30 per cent of fuel can be obtained by its use in open hearths in place of producer gas; and a larger number of heats can be obtained in a given time; coals of almost any analysis can be burned in the pulverized form and they can be burned in the pulverized form regardless of the percentage of ash; and finally, pulverized coal can be prepared at a cost ranging from 20 cents to 60 cents per ton—the cost varying, of course, according to the quantity of the coal handled and its moisture content.

The use of pulverized coal in locomotives is making headway, and has shown very satisfactory results. It is, of course, smokeless; it reduces manual labor; it eliminates sparks with their attendant fire losses; poorer grades of coal can be used; there is the ability of maintaining full boiler pressure at all times; there is a reduction of back pressure in the cylinder, due to enlarged exhaust nozzle; it should be mentioned also that grates, ash pans, firing tools, etc., are eliminated; and finally, there is a reduction of firebox and boiler repairs and more uniform firebox temperature.

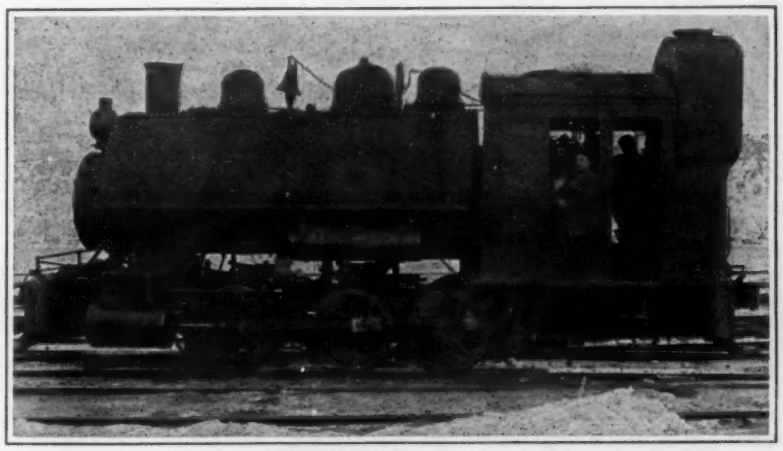


Screw conveyor for feeding powdered coal to furnace

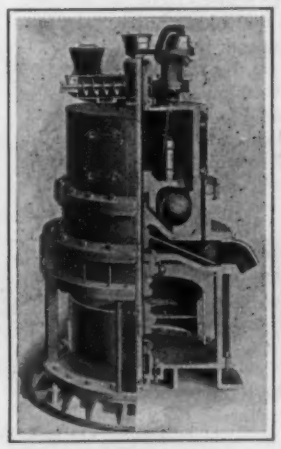
In the report above referred to, made by the Naval Consulting Board, the advantages of its use for the merchant marine are: It is smokeless; by an immediate adjustment of the burners, powdered coal may be made to emit a smoke screen; in an emergency the ship's boilers may be rapidly forced and the speed of the vessel increased; there is a great reduction in the fireroom force; and finally, since the supply of fuel oil in the United States is limited, the use of powdered coal as a fuel for merchant ships would serve to conserve fuel oil for vessels equipped to burn oil exclusively.

The Board considers it feasible to equip merchant ships with the requisite machinery for pulverizing and burning coal, and it earnestly recommends that the Emergency Fleet Corporation prepare plans for such installment on ships, and that an experimental shore installment be built at the Annapolis Experiment Station.

In the pulverizing mills, coal of a size that will pass through a one-inch ring is fed (see illustration) to the mill from an overhead bin by means of a feeder mounted on top of the mill. Leaving the feeder it enters the pulverizing section, which consists of four steel balls which roll in a stationary concave grinding ring, the balls being propelled around the ring by four pushers. The material finally leaves through a discharge spout at the bottom. The powdered coal is delivered to the furnaces by means of a screw conveyor, as shown in our illustration, being fed to the same from a hopper, and entering the furnaces, mixes with the desired proportion of air.



Yard engine, fired with powdered coal



Powdered coal pulverizer

The Air-Raid Alarm

AN organization of automobile owners in London, has rendered valuable service to the public in connection with the raids of the German air pirates—a service depicted on our cover this week. When warning of an air raid is received in the city explosive sky rockets are fired from various points. The automobiles then drive through the city streets, honking their horns to attract attention. On each side of the car, above the motor hood, a large sign is carried, on which is printed the warning, "Take Cover."

When the danger is passed the reverse side of the sign is shown, which reads, "All Clear." A Boy Scout bugler who rides in the car also assists to inform the citizens that the Huns have departed.

The drivers of the cars wear a uniform which include a metal helmet similar to that worn by the soldiers in the trenches. This latter is worn for protection against shrapnel from the British anti-aircraft guns, which usually provide the raiders with more or less special entertainment.

The Current Supplement

THE fossil remains of a human being have been discovered in Florida under circumstances that indicate he existed at a very early period of the world's history, and considerable discussion has arisen as to the correctness of the period assigned to the remains. A valuable contribution in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2214, for June 8th, entitled *The Pleistocene Man of Vero, Florida* reviews the facts and presents a careful summary of the evidence. Farmers, and railroads also, suffer severely every winter from the results of high winds and drifting snow, which frequently blockades transportation for days at a time. An article on *Tree Planting to Control Snow and Wind* tells how a considerable measure of protection can be secured, and methods of planting trees. It is illustrated by a number of photographs. This issue contains the fifth of the lectures on *Problems of Atomic Structure. Gathering Kauri Gum in New Zealand* describes, with excellent illustrations, a curious industry of considerable commercial importance, as this gum is extensively used in making varnishes and paints, and is found in no other part of the world. The big gun with which the Germans have been shelling Paris, although it has been discussed from many points of view, still arouses interest, as it has opened up new lines of thought. In this connection is the comprehensive paper on *Long-Range Artillery Calculation. Remarks on the Temperature of Space* discusses a subject that will be of interest to many. *The Pyranometer* describes an ingenuous instrument, devised at the Smithsonian Institution, for measuring sky radiation, and the article also tells something of the manner of using it and of results obtained. Illustrations make clear the construction of the instrument. *The Electroculture of Crops* reviews the history of a class of experiments that are beginning to be regarded with increasing importance in view of the threatened world shortage of food. Other articles are *Detecting Organic Impurities in Sands; Some Reactions of Acetylene; A New British Oil Industry; Magnesite* and *The Standardized Infant.*

Why Iron Chimney Stacks Corrode Quickly

THE cause of corrosion of galvanized-iron extensions to chimneys is laid generally to condensation which forms inside the stack, and which in conjunction with the carbon which has been deposited in use, creates a galvanic action which soon destroys the zinc coating and finally eats through the iron or steel base. To prevent the condensation an air space around the stack is recommended. The stack is made double from the base to a point close to the top, with small iron braces between the inner and outer casings. These may be riveted close to the ends of the sheets in course of construction. The air space may be one or two inches, according to size of smokestack, and local conditions.

Strategic Moves of the War, May 28th. 1918

By Our Military Expert

THE German offensive against the western front, *i. e.*, the principal effort to break the British lines, ended practically in the beginning of April, though strong attacks on the northern front and around Ypres continued to the end of the month. The first onslaught toward Amiens was the main battle, the terrible struggles around Messines, Kemmel Hill, and in the valley of the Lys being only secondary to the main object, which was the breaking of the western lines at the junction point of the British and French troops. It was evidently the intent to seize Amiens, to drive the French south toward Paris, to corner the English troops in northeastern France and, by advancing down the Somme valley, to obtain access to the Channel coast. The Germans had two alternatives, one the move outlined above, the other to break the French lines at or near Rheims and to move on Paris. But the capture of Paris would by no means end the present struggle; it was essential that the Entente armies in the field be beaten and German supremacy fully established before hopes of a favorable peace could be obtained. So far as both strategy and ultimate results are concerned, the move toward Amiens was sound in theory and well conducted in practice at first.

But the unexpected Allied resistance and weather conditions also forced the enemy into what may prove to be a dangerous salient for him toward Amiens, though he is left with many choices that can be made when the German offensive again breaks forth. In the constant search for weak points in the Allied lines so far in this campaign, only one part has escaped a test on the entire distance from the North Sea to the Ailette River; that portion is the stretch from La Bassée through Lens to Arras constituting what may be better known as the Vimy Ridge sector. Through this stretch of 20 miles there are massed fifteen or twenty divisions under General von Bülow and a strong offensive here attended by success would turn both the Amiens and Ypres front and would also give a short line for a rush to the coast.

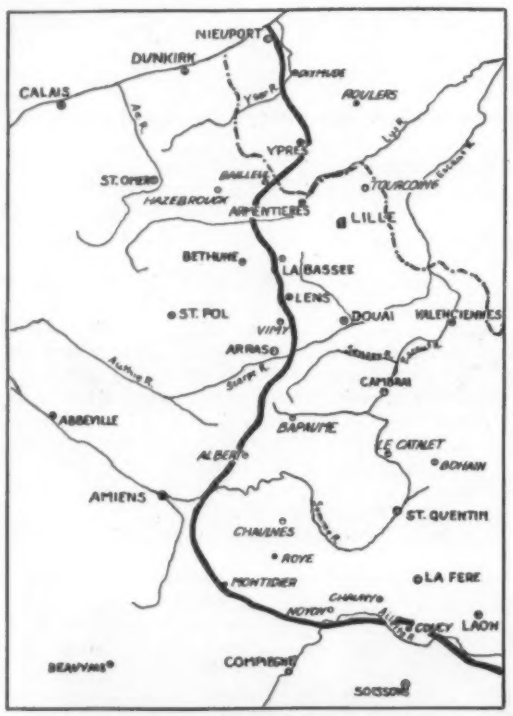
At present in Flanders there is a strong concentration of English and French troops opposed to the Germans; these troops have continued in force a "nibbling" process that has already gained much ground toward Mount Kemmel with promise of much more; minor successes have gone far to restore the morale of the Entente Allies here, while the Germans have made no progress in the Lys valley; in fact the French have retaken Locre before Mont Rouge and are pushing on toward Kemmel proper and Dranoutre. In the Somme salient the German advance was stopped entirely more than a month ago and has not yet been renewed. South of the Oise in this salient the enemy may attack again but there has been so far, no sign of any great concentration of troops here. The most probable point of attack in force would appear to be between the Scarpe at Arras and the Oise around Noyon; for there are on this line three objectives that could be followed, *i. e.*, from the Montdidier-Noyon front toward Paris, straight to Amiens along the Somme, and the front around Albert toward the north and west. Upon the whole, the last appears to contain the most likely point of attack, because, by the successes in the Lys valley, already a salient around Arras in the north has been produced and a second to the south would lead to a gain of much ground behind that vital point. In the rear of Albert nearly all the railroads supplying the Entente forces center at Doullens and its capture would greatly interfere with the lines of communications of the French to the south and of the British to the north, especially as the lateral communications of the Allies behind this part of the lines are very bad, probably worse than elsewhere. For the Germans the ground is better here than in the marshy valleys of the Ancre, the Somme and the Avre.

On the part of the front around Montdidier and Noyon, the French are no doubt better prepared to meet an attack than at any other point of the line while the narrow apex of the salient towards Amiens would seriously hamper all military movements of masses. It would appear so far that the Allies are leaving the great offensive to the enemy to select such points as may appear to have for him the greatest advantage, the most valuable of which now seems to be from Albert to Arras or from Arras to La Bassée. Around Arras the German forces have not yet been called upon for hard work, but it is now probably intended to assign to them important functions. The Germans are gathering their armies of maneuvers far to the rear of the lines and are exercising them daily in the practice beforehand of what they are to do. These armies are no doubt larger than the masses that made the grand rush of March last but the quality of the troops that have been assembled must leave much to be desired.

The Germans would seem to be awaiting the return of the offensive spirit of their men that received so severe a check in the recent advance. No troops can have experienced such losses in their effectives without having their all-round fighting efficiency seriously impaired for a long time.

It would now appear that, when the offensive is again resumed, a renewal of the effort to separate the allied armies will be made by a strong concentration against their lines of communications. Such attacks may even extend beyond Laon and Rheims where the excellent railroad communications of the Germans might enable them to attempt a surprise with a view of drawing the Allied reserves to the south and away from the principal offensive fields of action. But, the question with the Allies is not what they can do but to learn why Germany does not press her advantages; up to the present it cannot be seen why she has waited so long; on the surface it would seem to be a play against time—a play that has been influenced by political as well as by military considerations. So far the Central Allies have been most fortunate in their ventures; Belgium was overrun because it was not believed Austria and Germany would violate treaty obligations. The incompetency of the Russians led to their great defeat at Tannenberg just when their invasion of Germany appeared to be most surely successful.

The lack of foresight in preparation led to the inability of the Entente Allies to follow up advantages at Gallipoli when everything pointed to the fall of the Dardanelles defences and to a free road to Constantinople—the ultimate results would have been an open route for Russia to the sea and the driving of the Turks from Turkey into Asia Minor. The same story of Teutonic good fortune, aided by foresight, led to the defeat of Serbia, the collapse of Rumania, and the Italian disaster last year on the Isonzo.



The Battle Line from the Coast to Soissons

But this good fortune appears to have finally failed them on the western front, where despite the careful preparations, aided by surprise and most favorable weather conditions, the Entente Allies held and checked all advance toward the goals aimed at. The long delay in pressing a further advance has allowed the Entente Allies to secure a combined command instead of a divided one, and has permitted the strengthening of positions and the assembling of reserves in such numbers that they feel confident of resisting a drive, no matter at what points on the western front it may be directed. On the other hand, the Germans claim the long delay has enabled them to collect reserves from Germany proper and from the eastern front, while Austria has been drawing from Rumania all troops that can be spared to help in the long threatened drive against Italy. It is, however, safe to assume that such reserves have exhausted the available supply in both countries as it is impossible to believe otherwise than that the man power of the Central Allies is rapidly declining. The number of their present reserves in the field may be as great as before the western drive began in March; but the quality must have greatly deteriorated. The question of insufficient food, combined with the use of immature boys to fill up the ranks, must have gone far to injure the morale of their troops, who cannot have forgotten the terrible losses in March and April. It is presumed the Germans still have on the western front two hundred divisions with possibly eighty held in reserve; when the final clash comes, it will probably be on such a scale as to surpass any powers of description.

One of the lessons that have been learned in this war, when intrenched positions are attacked, is that, whenever all circumstances are favorable as regards preparations and number of troops employed, there is a definite relation between the length of front attacked and the depth to which an advance can be made; on the average the depth is fifty per cent of the length of front. On the Somme drive, the German attack from Arras to the Oise was on a front of 70 miles and the advance was 35 miles, while at Arras the Entente Allies attacked on a front of 11 miles and advanced five miles. Under present conditions on the western lines, but little progress can be allowed to the Germans since a glance at the map will show that, if St. Omer on the north and Abbéville on the south were taken, the British, Portuguese and French would be shut in so narrow an area toward the Channel that it would be impossible for them to maneuver and disaster would certainly result. Before this article is printed, the long and nerve racking suspense will no doubt be broken and a thrust will be in progress by one side or the other, most likely by the Germans for it is known that General Foch is carefully husbanding his reserves so that he can have sufficient numbers on hand to throw into the most threatened parts of the lines. The daily combats and artillery duels from Ypres to the Oise give little or no information where they should be concentrated in the near future. As the Channel ports are now the great need of the Central Allies, they are the main objectives and are giving the Entente commanders much information as to the main points of attack in any future drives.

There is no doubt that the Germans have massed an enormous number of men and quantities of material to endeavor to break through the Allied line at several points. Their strategy calls for overwhelming the British army, for the capture of the Channel ports and the cutting of British communications both with England and northern France, and for the capture of Paris. There are a number of secondary objects such as the capture of Amiens, Doullens, Arras, etc., but these are of little military value compared with the three principal aims given above. The latest reports mention attacks in Flanders near Locre and Voormerzeele on the northern leg of the salient there. But more important still is the news of the apparent beginning of a new drive on the Aisne front between Soissons and Rheims that started on the 27th instant; this battle is being fought out on the line along the Ailette River and the Chemin des Dames to the north of the Aisne where the French made their advance some time ago. If this is another drive on a new sector, the Germans have taken a decision directly contrary to what has been predicted by military writers during the past few weeks. It was generally believed that the Germans were so heavily involved in their campaigns in Flanders and on the Somme and were occupying positions so dangerously exposed that they would not dare to begin extensive operations in any other sector. To meet such an attack, however, it is evident from official statements that new dispositions of Allied troops have been made along the Aisne front as mention is given of British troops there; it is almost a certainty too, that American forces are on this front and are now engaged in the fighting. The front between Soissons and Rheims is a strong one for defense and offers to the Allies excellent facilities. The terrain is hilly and gives many strong natural positions in the rear of their present lines. The true intention of the Germans in making the two attacks simultaneously has not been disclosed; but it is probably with a view to gain the Channel ports on the north and to strike for Paris on the south; that city is only about seventy miles away.

Except for minor operations little has so far occurred on the Italian lines to indicate where the Austrians will make their long awaited drive toward the plains of Lombardy; the natural move would be to outflank the Italian left by an operation in force on the west of Lake Garda toward Brescia. But this would require numbers of men and quantities of material that cannot well be spared from the mountain areas and from the east bank of the Piave River. One obstacle to active operations continues to be the weather which is rainy, foggy and cold, especially in the mountains. But the snow is rapidly melting under the combined influences and the mountain passes will soon be clear for troop movements.

The Saloniki front has offered some gains in Macedonia but especially in Albania west of Koritza where positions have been carried to overcome a very pronounced salient. The difficulties of military operations in this country cannot be overestimated, for railroads are practically non-existent, there are few if any roads, and even mountain passes cannot always be found to allow of forward movements.

The Airplane Propeller

Some of the Problems it Presents, and How They Are Attacked

By C. H. Claudy

THE flying mechanism of the bird and that of an airplane are very simiar, but with one fundamental difference. The bird has wings; so has an airplane. The bird has a brain; so has the airplane, in its operator. The bird has a source of power, in its muscles; so has the airplane, in its engine. But the bird has no means of applying its power except by the same wings which support it—the airplane has. The wings of a bird are by turns supporting and propelling surfaces. In the first case, when the bird is in a gliding or soaring flight, its outstretched members perform for it exactly the same function that the wings do upon a plane; in the second instance they perform for the bird the function which the propeller discharges for the plane.

The propeller, then, is one of the four vital parts of an airplane, the others being wings, engine and pilot's brain. The efficiency of the propeller largely determines the efficiency of the plane, and its strength and reliability the safety of the flying mechanism.

It is, then, perhaps somewhat strange that no part of the plane is more the product of experiment and rule of thumb and less the result of scientific planning, than is the propeller. But it is only one of many mechanical contradictions which our as yet almost infant-like appreciation of the extent of the powers of nature admits. The belt, admitted to be, mechanically, a wrong and inefficient method of power transmission, is still standard. We get but a small per cent of power from the coal we burn, but it is the best we know. And while we calculate and make wind tunnel experiments without end, our propellers are still at best but an inefficient compromise between strength, efficiency, lightness, waste power and available thrust.

If there be any who doubt this, let it be said that there are even now two theories of propeller construction and both of them produce what we are pleased to call "good results." If two differing theories produce results which, no matter how good we call them, are less than perfect, it is fairly obvious that neither one is correct or really deserves more than the appellation "hypothesis."

The first of these treats the aerial propeller exactly as the marine designer considers the marine propeller—as a screw which, theoretically, in one revolution, should progress through the medium in which it works by an amount equal to its pitch, but which fails to do so by an amount known as the slip. Marine experiments and long practice have shown that any propeller, perfect according to this theory—that is, with no slip—would be of no value as a propeller for the simple reason that without slip there would be no thrust.

With this plain contradiction in mind, however, designers have for years stuck to the "screw" theory of propeller manufacture because, like the belt for power transmission, no matter what reason and theory said about it, it worked. And of course, when the demand arose for the manufacture of a propeller to produce thrust in the air, the same theory was used.

The newest experiments, however, have given this process of propeller reasoning a decided black eye. The theory of "similitude of propellers" admits not only the possibility but the advantages of passing from one machine to another with the same type of blade, that type to be determined in wind tunnel experiments, and casts into the discard all ideas of calculating the diameter, pitch, slip, width of blade, number of blades, camber, etc., from a consideration only of the plane and its purposes. The development of this theory considers the propeller as a pair of aerofoils set at a certain angle of incidence, moved against the air in a rotating path.

It has been found by experiment as well as theory that the laws governing the action of aerofoils, as deduced from the performances of the planes and other surfaces of an airplane, apply also to propellers. Thus, the "aspect ratio" of a propeller works out much as does the "aspect ratio of an airplane. In theory, at least, the longer the blades, the less the widths and the less the angle of incidence, the greater the efficiency.

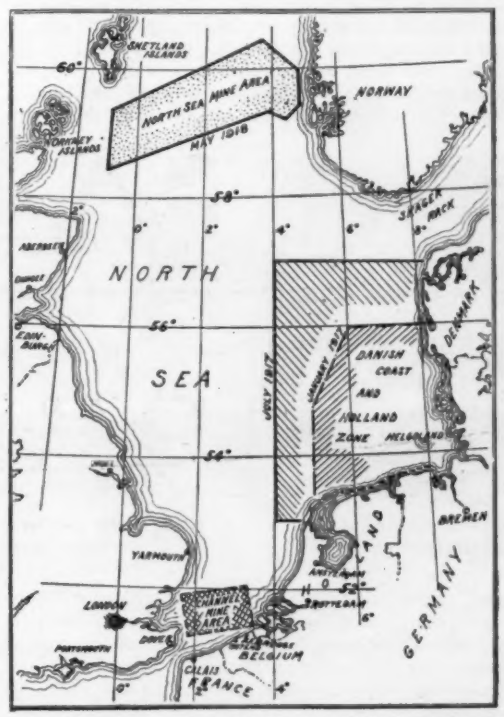
Practical considerations impose a sharp limit, of course. A propeller must be made of wood. It can be made of not greater length than will fit into the general design of a plane, since to increase the length is to increase the height of the machine from the ground, which means a larger, heavier landing gear, which means more weight, greater resistance and an alteration of the balance of the machine. A wood propeller loses strength rapidly as it becomes more and more attenuated; and strength for a "high aspect ratio" cannot be provided, as it can for the planes of the airplane itself, by braces, wires and struts.

A propeller must be made of wood for many reasons, chief of which is that no other material of which we have knowledge is so strong for its weight. Aluminum, lightest of the metals, weighs 162 pounds per cubic foot. Walnut weighs 38 pounds for the same quantity. Aluminum has a compression strength of 12,000 pounds per square inch—walnut, 6,100 pounds. Aluminum has a tensile strength of 15,000 pounds per square inch—walnut ruptures at 11,900 pounds. In other words, aluminum weighs four times as much as walnut and hasn't twice its strength.

Still other considerations in favor of the use of wood over metal are found in its elasticity, the smoothness with which it can be finished, the fact that it does not rust or corrode, and that balance is easily attained. Hickory, white oak, ash, walnut, mahogany, are all good propeller woods, with walnut and mahogany perhaps, the favorites as combining strength and ease of finishing to a high degree.

In designing a propeller the maker sets before him as his first principle the fact that a propeller has but one function—to transmute power from the engine into thrust. This it does by the reaction from pushing the air backwards as it revolves, just as a marine propeller thrusts water to the stern.

There are two components of the action of a propeller—one being the thrust, the other the drift, as the airplane manufacturer speaks of total resistance. But the drift of the propeller is made up of many different things. First is the active drift, which is produced by the motion through the air of the useful parts of the propeller—it corresponds to the active drift of the movement of the planes of an airplane through the air. Second, passive drift, which results from all of the propeller which is "detrimental surface"—for instance, the boss and roots of the blades. It corresponds to the passive drift of all the plane which is not engaged in lift—wires, struts, landing gear, etc., which interpose resistance not compensated for by any active lift. Third, skin friction,



Map showing various British mine fields including the latest between Norway and Scotland

which results from roughness of surface. Fourth, eddies, which result from any disturbance of the air by a moving surface, but which may be minimized by proper design. Fifth, cavitation, the tendency of the propeller to make a "cavity in the air," to create a semi-vacuum, or area where the air pressure is below normal. In other words, beyond a certain point, an increase in propeller speed results in a decrease in thrust, just as it does with a marine propeller. When the "slip" attains 100 per cent, the thrust stands at naught. It is theoretically possible to revolve either a marine or an aerial propeller so fast that no thrust results. It is because of this factor that aerial propellers are invariably two bladed rather than four or six. To the untechnical it seems that if a two bladed propeller, making 1,200 r.p.m. is efficient, then to add two more blades would be to double the efficiency. But it wouldn't. It it would, then running the two bladed propeller at 2,400 r.p.m. would also double efficiency, but cavitation to a large degree sets in at such speeds. Moreover, excessive speed means great strain and the thrust-drift ratio alters with the speed, the total drift increasing more rapidly than the thrust because of the rapid increase of the passive drift with increase of speed. The four bladed propeller, in theory, would give the same efficiency as the two bladed, if run at half the speed, but the passive drift would be doubled without any gain in thrust, and weight would be doubled without any gain in efficiency. Were a one bladed propeller a mechanical possibility, it might show a marked increase in efficiency over the two bladed, but as long as the laws of momentum and inertia remain as they are—and they seem likely to persist for some time—the use of a one blade propeller is not possible.

Indeed, not only must a propeller balance itself by having two blades, but those two blades must be absolutely identical in form, shape, size, curvature, area, finish and weight. Any difference between the two blades produces "flutter," a vibration which is extremely injurious to the engine and which may easily produce such stresses as to break the propeller. So important is this matter of balance that when a propeller is mounted for test on a steel shaft, that shaft supported on the finest of ball bearings, a weight of one ounce on one of the bolts through the boss must make the propeller move, the weight going down. If the propeller won't move under such a weight, or if it has a "point of rest" of its own, and will not stay in any given position in the whole circle of revolution, it must be altered before it can be used.

Very slight adjustments of weight in a very slightly unbalanced propeller can sometimes be cured by revarnishing the light blade, but the lack of balance must be small indeed to be so cured.

In designing a propeller, both calculation and experiment are used. Weight is determined by size and material. Size is determined by possible length, speed of engine, and the speed at which the plane is to go; the strength of the material is considered with relation to the strains the propeller will be subjected to in actual revolution. This leaves pitch angle as the principal thing to be determined. The pitch angle is the factor which determines the thrust (at any given speed), and it must be correct to within half a degree at all points of the blade if the blade is to be at all efficient. For the pitch angle is not a constant angle, but varies with every inch of length. This is a seeming anomaly—the propeller must have a "constant pitch" but does so by having a constantly decreasing pitch angle from boss to tips. The reason is found in the fact that the ends of the blades travel faster than the middle, the middle of the blades faster than the roots, yet all the propeller advances through the air at the same speed.

It may be plainer if one thinks of pitch angles on propeller blades as the angles of paths up a steep hill. Up two paths, of differing steepness, walk two men, both starting from the bottom at the same time. Both wish to arrive at the top at the same time. The man walking the steep path walks more slowly because the steep path is shorter—the man walking the less steep path must walk more quickly, because the less steep path is longer. In other words the "pitch angle" of the path of the swiftly walking man is less than the "pitch angle" of the slowly walking man, but both arrive at the end of their journey in the same time.

Not only is it essential that from root to tip of blade the pitch angle fade out uniformly from its steepest to its least, but both blades must be alike in this respect. If one blade has an error in pitch angle it is far, far better that the other have the same error than that the other be correct. For the blade with the error in manufactured pitch over calculated pitch will be less efficient, will give less thrust at a given speed of revolution, will bend less in consequence of the decreased thrust, will tend to move faster than its fellow because of the less resistance due to the less thrust; and as a result, though it may balance perfectly by a weight test, the propeller will be actually unbalanced, with resulting strains and stresses which

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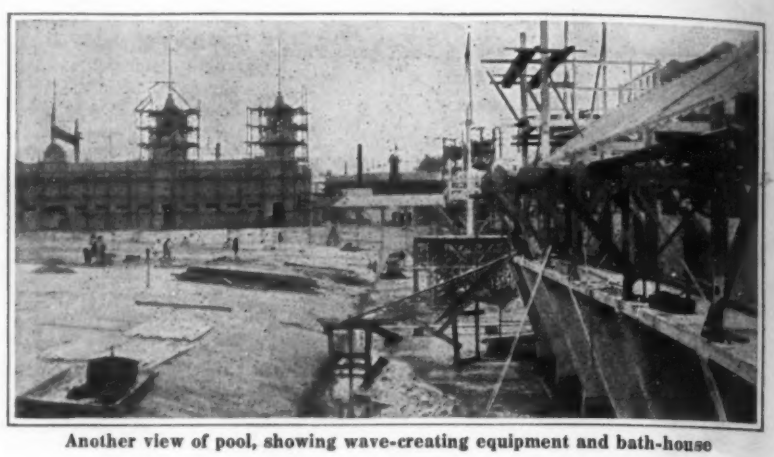
The Latest North Sea Mine Field

THE latest information from abroad regarding the mine field established by the British Government on May 15th reveals an error in the plotting of the field as described and illustrated by Archibald Hurd in a London daily paper. This mine field, as reproduced in our issue of last week, was in the approximate shape of a huge triangle with two of its sides 650 miles long. Later information shows a mine field with boundaries as drawn on the accompanying map; and certainly a field of this size and in this location is much more reasonable than the huge triangle above referred to.

The present mine field is roughly between fifty and sixty miles in breadth and 200 miles in total length, measured along its sides. It will be noted that while it extends to the three-mile limit on the Norwegian coast there is a wide gap between the westerly edge of the mine field and the coast of Scotland, where the water has been left open for ocean traffic. The area of the mine field is about 12,000 square miles.

On our map we show also two other mined areas. The field at the entrance to the Straits of Dover was laid for the purpose of closing the North Sea on the south. This area extends from Holland to the British coast, leaving to east and west sufficient unmined area for traffic to proceed up and down the Dutch and English coasts. This mine field was laid early in the war. Also we show the very extensive danger area for the Danish and Dutch coasts, which closes or is intended to close the exits from the German ports on the North Sea. This Dutch-Danish zone was first laid out in January, 1917, and was subsequently enlarged to its present dimensions in July, 1917.

Part of the large bathing pool, showing the mountains and waterfalls



Another view of pool, showing wave-creating equipment and bath-house

Behind the Scenes of an Exposition

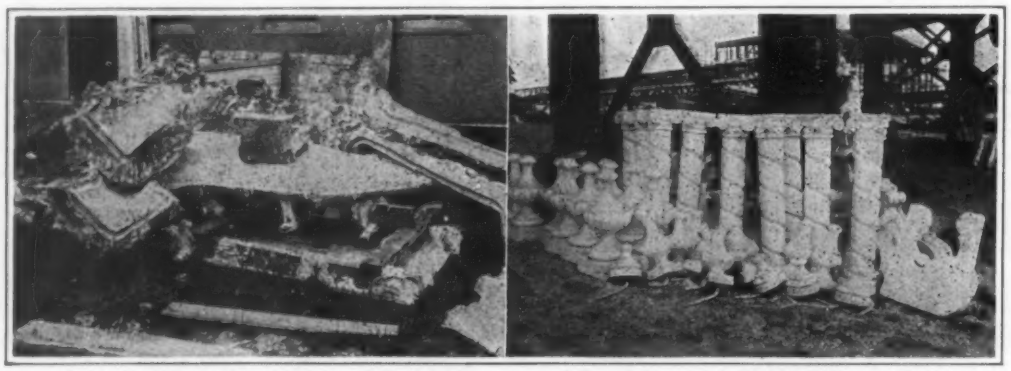
Activities at the New York International Exposition Before Opening the Doors

By Austin C. Lescarboura

SOMEONE once said that beauty is only skin deep. Presumably, the inventor of that homely axiom had the human race in mind; but it is possible that he may have been thinking of the exposition business. Be that as it may, the axiom fits the exposition business to a nicety.

To say that the beauty of an exposition is only skin deep is to pay the builders a worthy compliment. It brands them at the outset as highly practical men. It intimates that they could build structures of concrete and solid marble, with beautiful façades highly ornamented with hand-carved plaques and variegated stone arches and pillars. They could spend millions of dollars in making their structures the real thing. But what would be gained? In the first place, the cost would be prohibitive; in the second, the public would not know the difference, and if it did it would show no great appreciation.

So the exposition builders' problem is a two-fold one: he must build with the utilitarian point of view, and then surface his structures so as to make them inexpensive yet attractive to the eye. That he succeeds in full measure is evident from his work which we have seen in completed form at San Francisco, Jamestown and other expositions.



A corner of the plaster shop, showing some of the molds employed

Some of the standardized plaster ornaments for the exposition buildings

New York's First Permanent Exposition

Over 400 carpenters, painters, plasterers, plumbers, mechanics, electricians, laborers, supervisors and other officials are presently engaged in rushing New York's permanent international exposition to completion. The 28½-acre strip along the left bank of the serpentine Bronx River is a veritable beehive of human activity—a peaceful and constructive beehive too, for that part of the world seems far removed from the great war. Materials lie about in heaps; here and there are groups of men hard at work with woodworking and metal-working tools; in the sheds dark-skinned sons of Italy are fashioning beautiful ornaments in plaster; buzz-saws can be heard in temporary work-sheds; and electricians are laying wires along cornices and walls to outline exposition structures. Yet all this peaceful work goes hand in hand with our participation in the war; for our Government, appreciating the present opportunities for American export trade through the large number of travelers and buyers now in New York and other eastern cities, is encouraging this exposition where foreign buyer and native seller will be able to meet under the most favorable conditions.

If the exposition builder strives for appearances and invests huge sums of money in display, it is equally true of him that much of his investment must be buried from sight. In the exposition grounds, for instance, three and a half miles of sewer has been laid below the surface, much of it through solid rock. For the water supply to the various buildings and fire hydrants, over one and one-half miles of main pipe has been consigned to the soil below the 27,000 square yards of cement roadway. In addition, there is 11 miles of small water pipe spreading out in all directions from the main pipes or arteries.

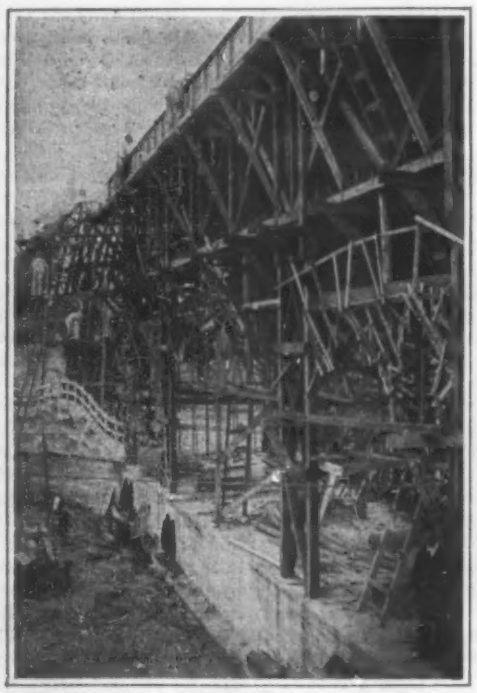
Figures for electric conduit and gas pipe are just as imposing; in fact, and as the director of publicity informs us in a somewhat woeful tone of voice, "Three hundred thousand dollars have been buried in these exposition grounds where the public will never see them."

To come back to the surface again: One of the first things that will catch the eye of the visitor is the large exhibition hall, to the left of the entrance. Manufacturers from far and wide will be there to present their products to curious and interested crowds, and it is believed that many sales and good will must result from such first-hand acquaintanceship.

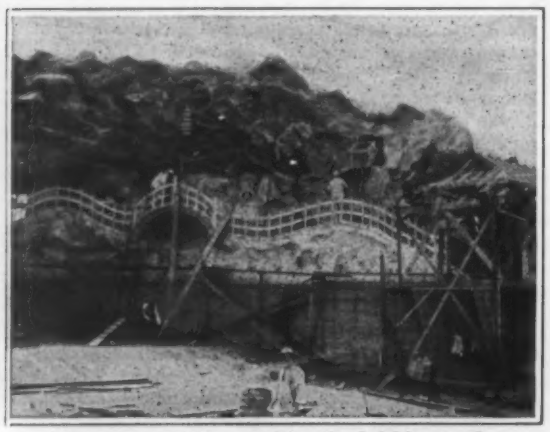
In front of the exhibition hall lies the steel shell of the old Holland submarine, which has been brought to the exposition grounds to serve as one of the leading attractions. Just now the submarine is in three sections held together by steel straps like a wounded warrior, because it was first believed that the steel hulk would have to be transported in sections. But when the time came old Holland No. 9 traveled whole and quite comfortably with its belly resting in a roomy gondola car and the tail extending over and supported by a flat car.

Being one of those ultra-clumsy things which must have a building raised over them and that cannot be removed afterward without destroying the building, it has been decided to shift the Holland to the front wall of the exhibition hall and then construct an annex extending over it. Any time it may have to be removed the only damage will be a demolished annex.

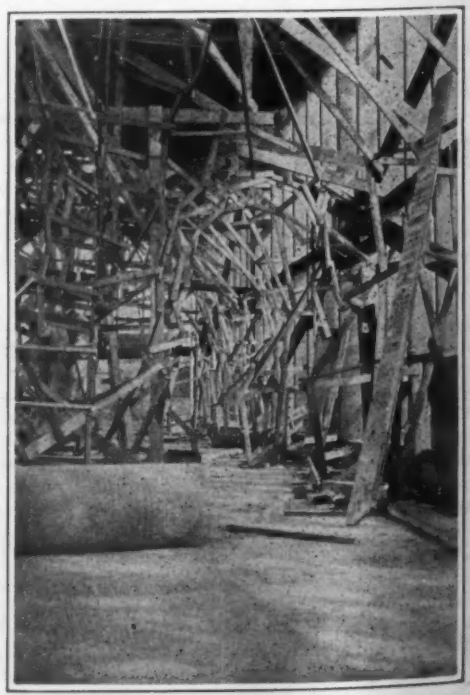
Near at hand is a huge carousal, which, at the time of our visit, was finished so far as the building was concerned; but the interior was in the throes of setting-up or assembly. It is no mean task to erect the working members of a carousal, judging from the behind-the-



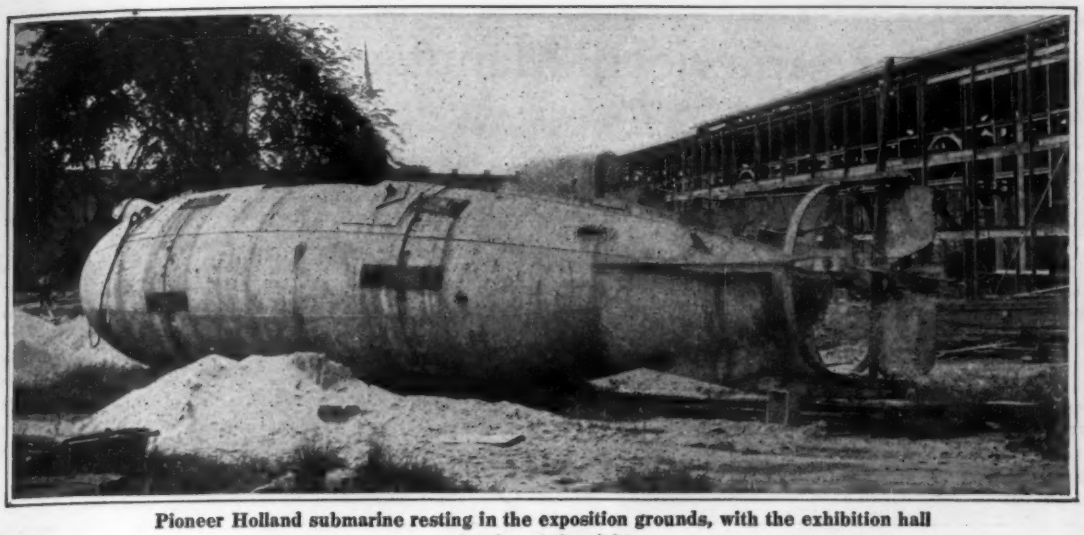
Carpenters at work on the waterfalls and grotto



Japanese mountains receiving the finishing touches



How rocks are built: framework of the grotto



Pioneer Holland submarine resting in the exposition grounds, with the exhibition hall showing at the right

Part of the façade of the bath-house in building

scenes study of the subject. The carousal, stripped of its trimmings, is not unlike a large umbrella. There is a center, stationary pole carrying horizontal radial arms and sloping rods to take up the weight. The arms are joined to a loose collar on the pole, while the rods connect with a ball-bearing pivot. The platform of the carousal proper, which is suspended from the radial arms, must be carefully assembled to ensure proper clearance for the surrounding stationary platform and the circular platform within. All in all, it is a very fussy job.

One of the busiest men of the lot proved to be the owner, Wm. Dentzel of Philadelphia, Pa. And this despite the fact that Dentzel is a sort of Rockefeller of carousals: at many different points he and his father

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Vacuum Cleaning the Pocketbooks for the Red Cross

THE recent Red Cross drive was productive of many very ingenious devices for inducing the indifferent and the reluctant ones to part with their money. One of the most novel of these devices was used before the New York Public Library. It was literally a "catch-penny" scheme. A vacuum cleaner was called into service, and while a soldier and a sailor urged the public to hand in their contributions the suction tube of the machine was reached out over the crowd. The suction was sufficient to draw up pieces of money of any denomination and deposit them in the bag of the vacuum cleaner. By this means it was possible to reach the crowd readily and it was unnecessary for a contributor to elbow his way through the jam in order to reach the Red Cross workers.

Copyright, Underwood & Underwood

Collecting Red Cross contributions with a vacuum cleaner

African Sudan Grass—The Emergency War Forage Crop

By Lemuel L. De Bra

COMING from far off Khartum in answer to the urgent need of Middle South farmers for a grass hay that would do well in dry sections, Sudan grass has not only proved itself a valuable forage crop under ordinary conditions but owing to the continued lack of rainfall western farmers are turning to the African plant this year as an emergency forage crop. Alfalfa is the standard hay crop in the West, but where water for irrigation is scarce, as it bids fair to be throughout the West at this writing, Sudan grass will produce a much larger yield than alfalfa. Moreover, it has been found a valuable plant to grow as a preliminary to reseeding alfalfa, the change greatly benefitting the soil.

It was in 1909 that the United States Agricultural Department received from the Sudan government the first shipment of "garawi" seed, the native name for Sudan grass. The southern states had long been in need of a good grass hay, and, noticing how well Johnson grass did down there, the Department undertook to find a similar grass but without the harmful root stalks that make Johnson grass such a pest.

The African grass adapts itself readily to a wide range of soils, which accounts for the rapid spread in its production. In very poor soil, it will produce a ton of hay and 600 pounds of seed per acre. As high as nine tons of hay and 1,200 pounds of seed have been produced, per acre, in warm, irrigated sections. Two cuttings are usually secured in the warm sections but it has been possible to get three or four by cutting the grass a little earlier each time. It grows from three to nine feet high and is a marvelous stooler, as many as a hundred stems having been found growing on a single root-stalk.

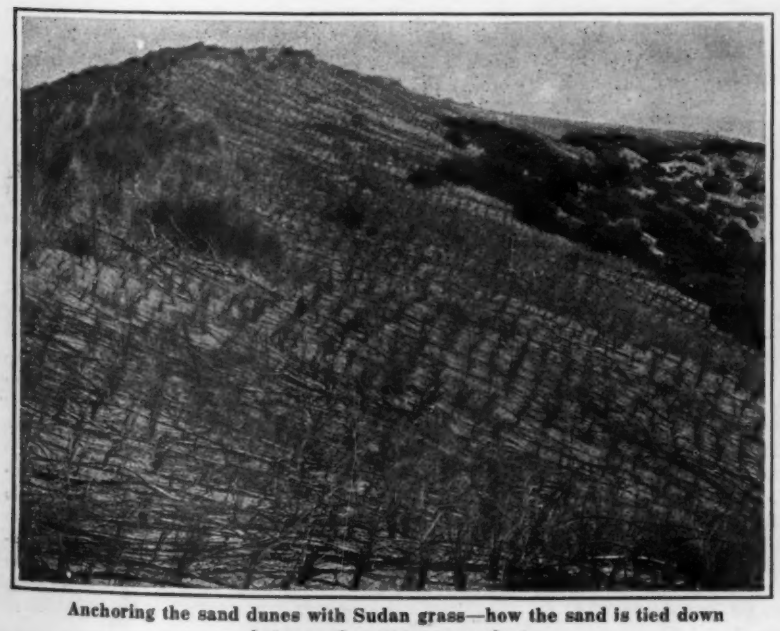
Conclusive experiments to determine its feeding value have not as yet been reported; but it is generally believed that Sudan grass compares with Johnson grass or good timothy hay as an all-around forage. In addition to its direct value as a crop, however, it has turned out to be a very handy plant to have around.

In California, along the coast line of the Southern Pacific Railroad, when the train left the fertile foothills and crept along the barren seacoast, the traveler used to look out the window over wide stretches of dreary sand dunes. Today, his sight-seeing eye gazes over wide, rippling green fields of Sudan grass; the plant not only ties down the sand but hides it from view. Moreover, at certain seasons of the year these fields are harvested; and land that was formerly barren sand waste is now producing fair crops of a valuable forage.

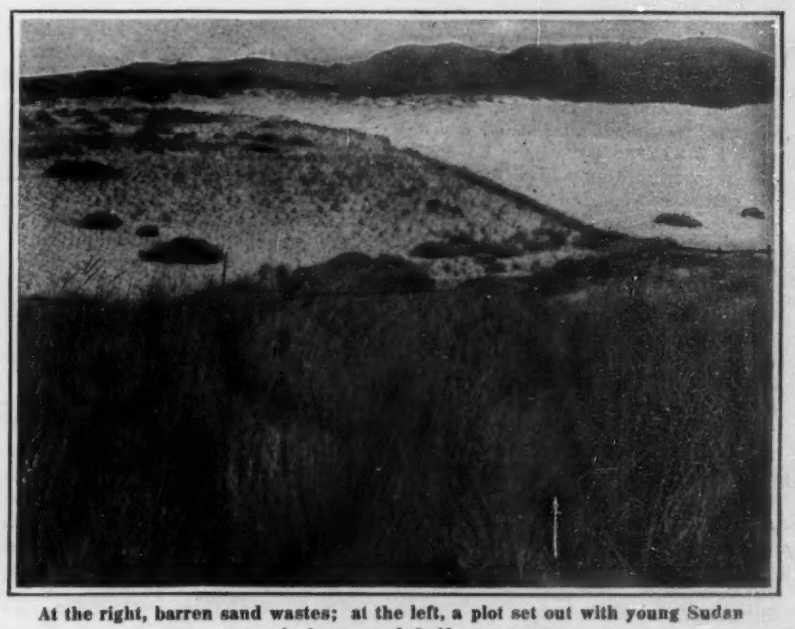
The young plants were set out in patches and the spaces between the plants were covered with brush. As soon as the plants had firmly rooted, the brush was removed and another patch started. The first plantings were made along the coast line several seasons ago, and it is now known that the African grass serves its purpose well.

But even this does not exhaust the possibilities of the new grass. An interesting experiment was made this season by western grain growers which demonstrated that it is possible to "corner" a fire in a grain field by "cutting" the field in parts with strips of Sudan grass. In past years many grain growers have suffered heavy losses from fires. This year several fields were saved by planting a border around the fields, and "cutting" it in quarters, with Sudan grass.

When the grain is ripe enough to burn, Sudan grass is still green enough to stop a fire. It is planted in strips eight to ten feet wide through the length and breadth of the field. The fire starts in one of the "quarters," burns fiercely until it comes to the barrier of green Sudan grass—and there it dies.



Anchoring the sand dunes with Sudan grass—how the sand is tied down between the young grass plants



At the right, barren sand wastes; at the left, a plot set out with young Sudan grass; in foreground, half-grown grass

World Markets for American Manufactures

Conducted by WILLIAM W. SNIFFIN

A department devoted to the extension of American trade in foreign lands

What Germany thinks!
"Germans all over the world: never again use English, French or Italian goods. Remember 1914!"

No Boycott?

AN acquaintance of German birth, who is—unfortunately for the Kaiser's cause—officially listed in Wilhelmstrasse as a good apostle of Kultur, shows us the little label which we illustrate. It came to him in a package of letters, under circumstances which would indicate that the Germans are using it about as we use our Red Cross Christmas stamps and our various "Win the War" postmarks.

We don't think that we need to point out the bearing which this relic has upon the Germanic program according to which everybody is to treat dear Germany, after the war, quite as though nothing had happened. It might even seem that this more or less official pronouncement of Germany's intentions would be a valuable contribution to the discussions now going on as to the advisability of a post-bellum boycott on German goods.

The American Motion Picture in European Theaters

FOR several years past the United States has been making steady gains in the export of motion picture films to practically all parts of the world. Reports received from nearly all the countries of Europe, the northern coast of Africa and South Africa, the Far East, Australasia and South and Central America, besides Canada and Mexico, show that the American film is delighting audiences wherever it goes. It is estimated that in the first 2½ years of the war more than 15,000 separate subjects were shown in the motion pictures of England and of these nine-tenths have dealt with American life and customs. The latest figures show that there are 4,500 picture houses in the United Kingdom, with an annual attendance of 1,075,000,000. The average number of visits to the motion pictures for the entire population is one every two weeks for each person.

The exports of exposed film from manufacturers of the United States increased from 32,192,018 feet in the fiscal year 1913 to 158,751,786 feet in the fiscal year 1916, falling during the following year to 146,342,191 feet, though the values rose from $2,276,460 in the year ending June 30th, 1913, to $6,757,658 in the year 1915-1916, and $6,948,932 in the following year. The enormous exports to the United Kingdom were much decreased during the year ending June 30th, 1917, from the high figures of the preceding two fiscal years. Exports to France, Canada and especially Brazil grew tremendously between June 30th, 1915, and June 30th, 1917. Figures for the subsequent months indicate that Italy and Australia are importing larger and larger quantities of American films.

Europe is by far the best customer for the United States in this line of goods, and France, Italy and the United Kingdom imported over forty-seven per cent of the total exports of motion picture films from this country during the first 11 months of 1917. The United Kingdom, during the fiscal year ending June 30th last, imported from the United States 58,316,100 feet of film valued at $2,817,773, as against 163,364,281 feet in the year preceding with a value of $5,946,599.

Scotland adopted the motion picture somewhat later than other countries, but in the district in and around Edinburgh there are now 66 such houses, with seating capacities as high as 2,000 and over. Many of these theaters are pretentious affairs, with buildings especially designed for them and equipped with the most up-to-date appointments. A score of American producers are disposing of their films in this vicinity—more than the combined number of producers from France, Italy and the United Kingdom in that market. The films are usually rented, but are occasionally purchased. New films rented to important houses will bring a return of from £60 ($292) to £100 ($486.65) for three days, but as the film goes to other theaters its rental decreases, though at no fixed rate. The smaller theaters, where new films are never displayed, can by bargaining secure 7,000-foot reels from £20 down to £8 ($97.33 to $38.93) for three days. Managers rent from agencies in Edinburgh and elsewhere.

The American pictures are of a high standard in every particular—scenic beauty, photographic art, variety of incident and sustained interest. Comic sketches from America are appreciated, but too often the plots supplied have little fresh humor. One desirable feature is that the films be true to life; for example, scenes regarding the seafaring life will fail before the seafaring people of the United Kingdom unless accuracy is maintained throughout. The better features of American outdoor life—especially the "Wild West"—are enjoyed, but in this class as in others, the demand is for plays of depth and fidelity to detail.

In 1916 there were 49 motion-picture houses in the city of Leeds in England, with a total seating capacity of over 35,000, but the surrounding suburban districts are estimated to bring the total number of motion-picture houses up to 100. Film renters in Leeds are, as a rule, sub-agents of firms in London and Manchester, and Leeds is the distributing center for Yorkshire. Every known producing firm is represented in the city and single films rent for £100 down. In Manchester there are four large motion-picture theaters with an aggregate seating capacity of from 4,000 to 6,000 persons. More than forty concerns are engaged in the business of renting films in this city and for the country for miles about, and American films furnish 75 per cent of those shown in Manchester, while the remainder is divided between British, French and Italian pictures.

As long as a year ago there were some 400 motion picture houses in Italy, exclusive of the smaller places to be found in every town and village of the country. Rome has 43 such theaters, 12 of which are patronized by persons of the highest social rank. The average seating capacity of Italian motion pictures is about 1,000. For the purpose of renting films in Italy, the country is divided into five districts—(1) Piedmont and Liguria; (2) Lombardy and Venetia; (3) Tuscany and Emilia; (4) Marches, Umbria, Latium, Abruzzo and Sardinia; and (5) southern Italy and Sicily. The government maintains a very strict censorship over motion-picture films, through the Ministry of the Interior, and licenses are required for exhibition. The customs duty on films is about sixteen cents a kilo.

Comedy and serious drama are popular in Italy, and modern themes with strong realistic and dramatic plots are much appreciated. American films have had to contend with a national prejudice against foreign plays by foreign artists and also with a feeling that rental prices of American films are too great. Nevertheless, they appear to be winning their way with Italian theater managers and audiences, as is indicated by the following figures, showing exports from this country to Italy for the first 11 months of the different years specified: In 1915, 397,680 feet of film valued at $27,589; in 1916, 11,046,155, feet valued at $275,469; and in 1917, 11,440,966 feet valued at $281,573.

Motion pictures are very popular in Norway and theaters are to be found in practically every town—some 175 in all, of which 24 are in the city of Christiania. These theaters accommodate from 200 to 1,500 persons at a time. Films from the United States and from home companies predominate in the market, though films from other countries are produced. The films are rented at from $50 to $225 a week and after display in Christiania, are sent to the smaller towns, where they are rented for as low as from $6 to $12 per week. An import duty is collected on all films brought into the country and amounts to 32.2 cents per kilo. The government censorship approval is a necessary preliminary before films can be shown in Norway.

American films have always been quite popular in Russia and Siberia. They have a good reputation for durability and the subjects are new to the audiences. Odessa, a city of 700,000 inhabitants, has 34 motion picture theaters with a total seating capacity of about 20,000. The demand in Russian theaters is for all classes of plays, including especially tragedies and plots involving strong tragic or criminal characters and classical subjects, such as "Quo Vadis," "Cabiria," "The Fall of a Nation" and "Macbeth," which have all been shown in Odessa within the recent past. American films have, however, not had the sale on the Russian market that Italian and French films have had, owing largely to the difficulties of shipping the films to the country.

The practical utility of the motion picture films is demonstrated by a very interesting development of the past few months in Russia. Motion pictures have been used in the prison camps in Russia to disseminate American propaganda among the 1,500,000 prisoners of war. The United States Committee on Public Information, through its chairman, recently announced the fact that the picture play was being used to reveal the real America and not the America so consistently pictured by the German press. No matter what happens between Germany and Russia, when the 1,500,000 prisoners of war get back to Germany, they will carry with them a knowledge of what America is fighting for, and they are going to be a powerful factor in forcing the democratic unrest now brewing in Germany to the surface. Very extensive exports of film have been going forward constantly to the Russians from the Committee on Public Information, which now maintains five motion picture theaters in Petrograd, one in Moscow and several in every prison camp in Russia and Siberia where Germans and Austrians are confined.

American Confectionery Abroad

THE United States has become one of the world's greatest exporters of confectionery. This trade extends to all parts of the world now and amounted in the year ending June 30th, 1916, to $1,904,101. Production in the United States for the latest year for which figures are available—the calendar year 1914—amounted to $170,845,000, representing an investment of $97,467,000 in 2,391 establishments. The best foreign buyers of American confectionery are England and Canada, which, during the years 1911 to 1914 took some 50 per cent of the total exports and in 1915 and 1916, from 40 to 45 per cent. Cuba, Australia, Scotland, the Philippine Islands and Panama as a rule rank next, though not always in the same order. One of the most important essentials for increasing the demand for American confectionery abroad is that it be carefully packed for export—in moisture-proof containers when it is sent to the Tropics or whenever it is to pass through the Torrid Zone on its way to its destination.

American candy finds a good market in Scotland, and marked increases in the sales are reported in late years in Dunfermline and its vicinity. Indeed, sales of American candies in this region have recently been exceeded only by those of English and Swiss manufacture. As long as a year ago five American confectionery houses were doing business in Dunfermline, four by direct shipments through New York and Glasgow and one large concern by a home trade through Edinburgh and London. There is an opportunity in Scotland for the sale of American bonbons, though chocolates and the cheaper middle grade of candies are also in demand. Exports of confectionery of all kinds to Scotland amounted to $82,031 for the year ending June 30th, 1916.

Since the export of confectionery from Great Britain was prohibited, New Zealand has turned very largely to the United States for its supplies, notwithstanding the higher duty that must be paid on goods from this country. The imports of candies into New Zealand from all countries increased from 924,360 pounds valued at $207,109 in 1915 to 997,421 pounds valued at $264,834 in 1916. The first three months of 1917, however, showed a drop to $84,682 from $191,258 for the corresponding period of 1916. During the year 1916 the share of the United States increased to $57,950 from $51,059 the year before. There is apparently a good demand for American confectionery if properly packed and prepared for sale in a moist climate.

In the Union of South Africa, American consuls report an unquestionable market for American candies. Indeed until recently several American manufacturers of confectionery were securing a fair share in this market, but increased freight charges, delay in filling orders and the general uncertainty of trade conditions have interfered seriously with the trade of late. All varieties except the medium-grade pure sugar candies must be wrapped in tin foil or oil paper and be packed in air-tight cases. From past experiences, it appears that sales of this commodity can be promoted best in this region by a manufacturers' agent. After a sharp decline of American exports of candies to South Africa in the year ending June 30th, 1914, American exports of confectionery to that country rose to $21,414 in 1915 and to $33,104 in 1916.

The Europeans and Japanese who have settled in China constitute a steady though limited market for American confectionery of all classes. The Chinese do not, as a rule, appreciate foreign sweetmeats. Imports of American confectionery into China (not including Hongkong) amounted to $9,948 in the year ending June 30th, 1916, an increase of $4,103 over the figures of the year before. Hankow is one of the best markets in China for these goods and American manufacturers should, while other markets are cut off, be able to secure a reasonable market for medium and cheap grades of chocolates and a small demand for the higher-priced kinds. In any case it is necessary to pack the chocolates specially for this market. In Hongkong, American manufacturers control the import trade in

(Concluded on page 538)

The foot-candle meter registering an illumination of 7 foot-candles

Measuring the intensity of light at the spindle of a lathe

Interior of the light box showing position of the lamp

Is the Light Sufficient?

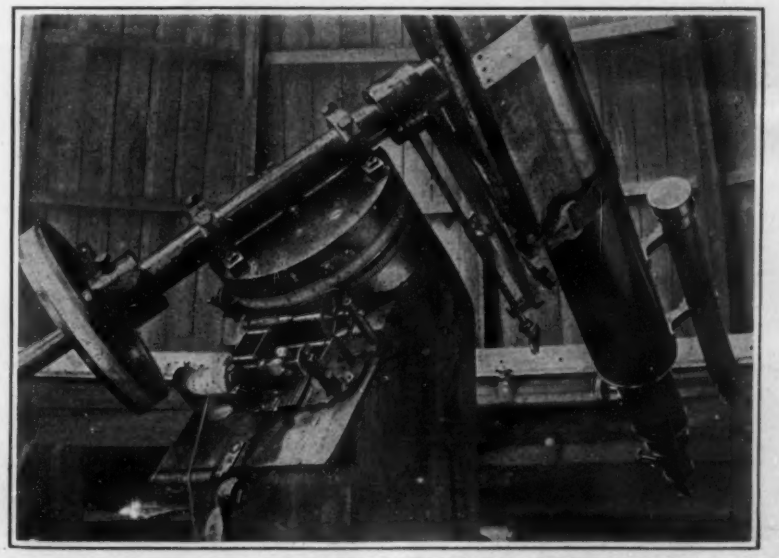
ALTHOUGH the eye is the most sensitive organ we possess, little attention has been paid until recently to the conditions under which it must function. It may be called upon to distinguish objects in dim twilight, or in the glaring blaze of a tropical sun. Fortunately it is very adaptable and has stood up under a great deal of abuse. But we cannot have good vision throughout such a wide range of light intensities and we are now trying to adapt the light to the eyes instead of the eyes to the light. This not only saves the eyes but results in economy of light and a better output of work.

A show window should be brilliantly illuminated, but the same light in the drafting room would be distressing. A foundry should be lighted as brightly as a church, but it would be only waste of electricity to furnish it with the light intensity that is required for fine work in a machine shop. A cloak and suit department of a store, because of the dark shades of the goods, needs more light than the white goods counter. Thus, we have a wide variety of conditions to which the light must be adapted.

It is because there has been no simple instrument available for measuring light intensities that so little attention has been paid to the subject, in the past. Recently, there has been put upon the market a small foot-candle meter, with which illumination may be measured as readily as a thermometer measures the temperature. This instrument is provided with a small light box which is covered by a white screen. In this screen there is a series of perforations covered with a translucent film. At one end of the box there is a small lamp, which is carefully standardized to give a light of fixed intensity. The instrument is provided with a battery, a volt meter, and a rheostat. By turning the knob of the rheostat until the needle of the volt meter lies directly over an arrow, the lamp is brought to the standard intensity of illumination. The screen is carefully calibrated, so that the light shining through the perforations will range from half a foot-candle power to 25 foot-candle power. If, for instance, the light to be measured is five foot-candles, the light shining through the perforation marked "5" will be of the same intensity as the light on the surface of the screen, and it will seem to disappear from view, the perforations to the right being progressively brighter and to the left progressively darker. A table of standard illumination intensity for various classes of work has been worked out, and by means of this instrument it is possible to determine at a glance whether the light is too intense or insufficient.

A Home-Made Observatory in New Zealand

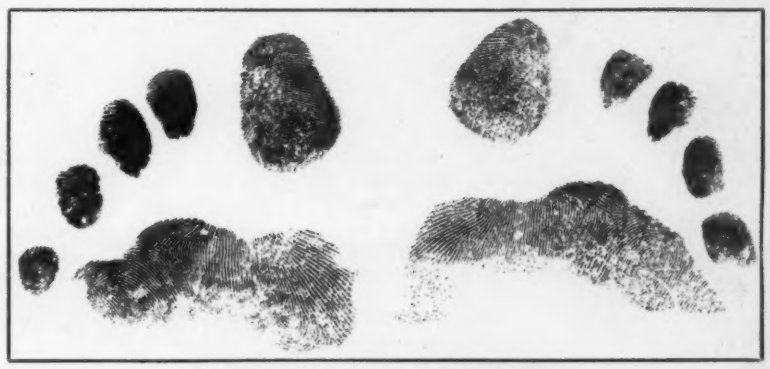
AT Stratford, New Zealand, a big dairying center, an enthusiastic farmer-astronomer, Mr. A. W. Burrell, has built an observatory which is quite unique in its way. The telescope is a five-inch one imported direct from the makers in London. But as the additional cost of an equatorial would have more than doubled the outlay, Mr. Burrell, who possesses building knowledge, decided to construct his own. To ensure the necessary solidity he hit upon the plan of building his observatory around the trunk of a large red pine tree, which he cut down to within about eight feet of the ground. This he squared off on four sides, and cut to the proper angles on top. He then built on it, unaided, an equatorial, with all the necessary adjuncts, laying down the meridian line, determining the polar axis, and constructing the hour and declination circles. The driving clock, made up from a miscellaneous collection of discarded wheels, performs its functions correctly.



The equatorial constructed by a New Zealand farmer-astronomer

A Court Room Puzzle

"HAVE his fingerprints taken," ordered a New York Magistrate in the Men's Night Court, after having convicted a prisoner on the charge of vagrancy. He did not see that the prisoner was without arms, and that fingerprints were therefore impossible; nor did the officer, who had been accustomed to taking orders, stop to make any explanation of the difficulty but proceeded to the fingerprint bureau to have the prisoner's prints taken. The fingerprint expert, however, after being puzzled for a while, solved the problem. Instead of taking his fingerprints he had his shoes and socks removed and took his toe-prints. Our reproduction clearly shows that the toes are covered with the same pattern as the fingers; an identification by means of toe-prints is therefore as reliable as one of fingerprints.



The "finger-prints" of an armless vagrant

Cod Liver Oil from Newfoundland

LARGE quantities of cod liver oil are produced in Newfoundland as a by-product of the fishing industry, but the quality of the refined oil was formerly much inferior to that prepared in Norway, and the Newfoundland oil was consequently not greatly esteemed in the United Kingdom for medicinal purposes by physicians.

Considerable attention has, however, been devoted recently in Newfoundland to the improvement of the quality of the cod liver oil produced in the island. In 1910 the government procured the services of a Norwegian expert, who has been engaged in the manufacture of cod liver oil in the Lofoden Islands, to instruct the Newfoundland refiners in the methods of preparing the finest oil. A system of government inspection of oil refiners was also introduced, and in May, 1916, an "Act respecting the refining of cod liver oil" was passed by which it was made compulsory for every refiner of the oil in Newfoundland to obtain a license and to observe certain rules and regulations in the preparation of the oil. Under the provisions of this act no refined cod liver oil is now allowed to be exported from Newfoundland without having been inspected and branded by a government officer. The result of these measures has been to bring about a great improvement in the quality of Newfoundland cod liver oil, and it is claimed that the refined oil is now equal to the best Norwegian oil.

The production of refined cod liver oil in Newfoundland has increased considerably in the last few years, but the bulk of the oil obtained is still of common quality. In 1913-14, 1,054,208 gallons of common cod oil were exported from Newfoundland, as contrasted with 26,218 gallons of refined; in 1914-15, 1,239,040 gallons of common against 47,170 gallons of refined; and in 1915-16, 1,313,280 gallons of common against 142,637 gallons of refined. It is evident that a much greater output of the refined oil is possible if satisfactory markets can be found for the product.

Rural Motor Truck Express Lines

AT the request of its highway transport committee, the Council of National Defense urges prompt action for the establishment of rural motor truck express lines wherever they may be needed through various States. The Council approves the widest possible use of the motor truck as a transportation agency and requests that all necessary steps be taken to facilitate such use. The investigations of the highways transport committee upon the operation of rural motor truck express lines over the main highways surrounding the population centers demonstrate the following important war advantages resulting from the establishment of this service:

1. Production is stimulated. Farmers invariably increase the variety and quantity of their production when regular marketing facilities are made available. In every section studied, a great increase in the variety and the amount of production followed the establishment of the rural express.

2. Farmers are relieved of their task of hauling their products to market, and the existing farm labor supply is thereby greatly conserved. The investigation shows that in some places the hauling done by five men with wagons can be done by a man with a truck at many times the speed. This leaves the farm laborers at work in the fields.

3. Additional food is made available by tapping the farm communities which have no other good shipping facilities. Much of this additional food is now either wasted or greatly deteriorated because of poor shipping facilities.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

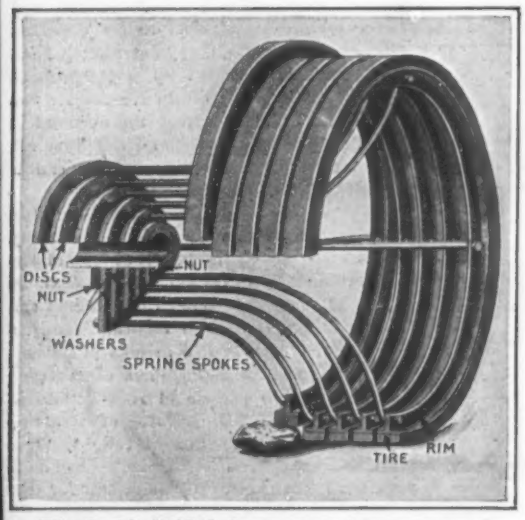
Charging Rack for Battery Lamps

WITH the importance of coal in our present crisis, the mines are adapting modern methods to as many of their processes as possible. The electric hoist and the battery locomotive are now common. In the gaseous mines, particularly, the electric storage battery lamp, has gained favor because of its steady light, safety and low maintenance cost. During the past three years nearly a half million have gone into use.

With these lamps a small storage battery is used, which is carried by means of a belt on the miner's back. The lamp, of course, is attached to the front of his cap. For the charging of these batteries various improvised methods were at first introduced, but as the equipments of lamps grew, better and more systematic methods were adapted. A half million electric lamps are in use.

The illustration shows a miner placing a battery in the sectional charging rack in the St. Michaels mine, Pennsylvania. Each miner has a number assigned to him and on leaving the mine he removes the battery from its case and places it in the section as easily as placing a book on a shelf. The battery automatically makes contact with contacts built into the rack and begins to charge. Each rack has space for 10 batteries and as many of these racks as are needed are assembled like so many sections of a modern bookcase.

Miner placing his lamp battery in the rack for charging



Wheel with divided rim, suggested as a means of minimizing small shocks

Wheel Rim of Independent Sections

THE wheel shown has a rim made up of five separate sections, although the number is not a matter of importance. Each section is provided with spring spokes attached to a disk mounted on a sleeve and secured in a suitable manner. Each section has its own disk, the inner section being connected to the inner disk and the outer section to the outer disk. Tires may be mounted on the rims in the usual manner if desired.

Of course, the idea is that should the wheel pass over a small obstruction, such as an ordinary stone that is likely to be in the roadway, only a single rim or perhaps two will rise. As the other rims stay on the ground, the shock is absorbed by those that rise, so that the occupant of the truck or automobile feels comparatively little jolting.

Focusing Device for the Hand Camera

ATTENTION has previously been called in these columns to the need of a focusing device for hand cameras. While such devices exist, there is still a wide field for the inventive mind along these lines. What appears to be one solution of the focusing problem is the invention of Albert K. Cummings and Louis Thompson of West Boylston and Worcester, Mass., respectively. These inventors place a supplementary lens on the lens board of the usual hand camera, in line with a large plano-concave lens and eyepiece at the rear and on the body of the camera. Obviously, the eyepiece is in line with the film or plate surface, so that as the lens is moved backward or forward the focusing of the image in the eyepiece corresponds to the focusing of the main lens.

First Aid for the Cotton Picker

AT first glance there seems to be a wide gap between the sore, tired knees of cotton pickers and the winning of the war; yet with the scarcity of labor in the South gathering the cotton crop is an acute problem, and cotton is needed as never before. Leather and rag pads are unhandy, and in damp weather uncomfortable and dangerous to health. The mechanical knee pad shown in the photograph, invented by Robert T. Jenney, overcomes the difficulties by combining comfort and unlimited service with practicality. This pad is made from strong spring steel that gives with the weight of the wearer, but holds its shape perfectly. The knee is supported at just the right height to keep the foot in a comfortable position. The rest, padded with felt, forms a hammock that absorbs shock when the wearer kneels on rough, uneven surfaces, while the broad flat runner enables the user to keep a perfect balance when in a kneeling position.

Paper Flower Pots for Transplanting

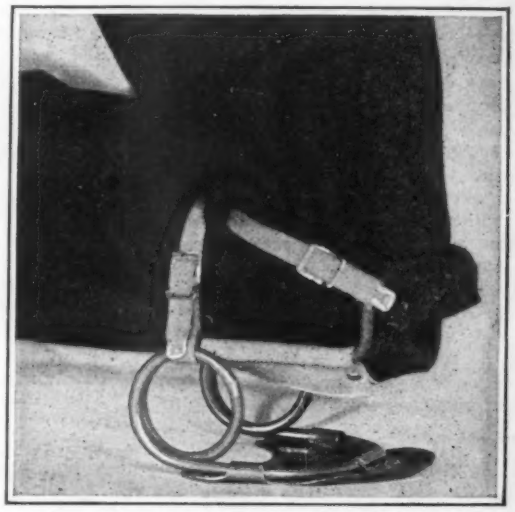
THIS spring, more than ever, the amateur farmer will pore over the fascinating pages of the seed catalog and plan his kitchen garden with an eye to getting the biggest possible yield out of his available land. The ground that he has to cultivate in his backyard, etc., is generally limited in area and for that reason it is well worth his while to start his plants indoors. This will assure him an earlier harvest or, better still, two crops of certain vegetables where otherwise he would reap but one.

But the average amateur farmer dislikes transplanting. More often than otherwise the tender roots are sufficiently injured in transferring them from one soil to the other to retard growth; and for that reason the work ordinarily involved is hardly worth the effort. However, someone has now come to his rescue and has devised a means that will help the practical and the amateur farmer in this particular.

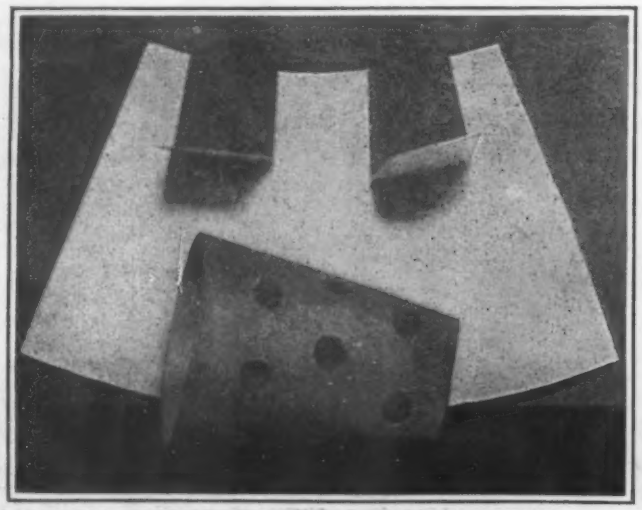
This aid to transplanting is in the form of a novel cardboard flowerpot. It comes in various sizes and, as our illustrations show, is perforated. When frost is out of the ground, and it is perfectly safe to begin transplanting, the delicate plants grown in these containers need not be touched. The flowerpot, just as it stands, is set well into the ground where the pasteboard soon rots away. This method not only saves labor but it gives the growing plants a much better chance to mature and to produce abundantly.

Cabbages, cauliflower, tomatoes, peppers, eggplant, stringbeans, cucumbers, etc., can all be grown in the cardboard flowerpots indoors long before it is safe to plant the seeds in the open ground. Dwarf beans, for example, can be started in the house in April; and a cardboard container from three to four inches in diameter will take care of from four to five seeds. These must be well distributed. In planting pumpkins or cucumbers, or any other vegetable which needs considerable area it is well to place two seeds in a pot from 1½ to 2 inches in diameter. If both germinate then one should be pulled up, leaving the hardier to mature for eventual transplanting in the kitchen garden.

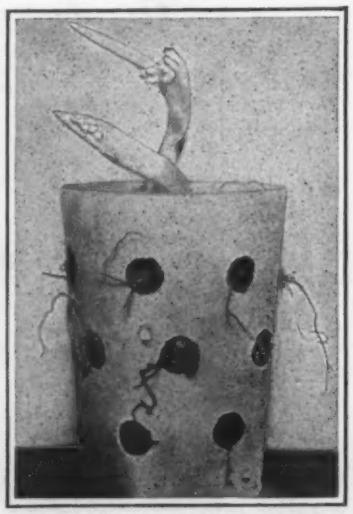
At a time when amateur gardening is in vogue from one end of the country to the other, there are many opportunities such as this one for inventors to come forward with new ideas by way of simplifying gardening.



Knee comfort for the cotton picker



The paper flower pot and the pattern from which it is cut



A sprouting plant ready for transplanting

Strange Old Coins of India

IN 1908 the independent state of Hyderabad, India, obtained a modern mint and called in the coins that had been current up till that time. The old mint of Hyderabad was little more than a coppersmith's shop in which scrap copper of all sorts was melted up, hammered into plates, cut up into very rough approximations of one tola in weight, and stamped between dies, one of which was in the anvil and the other in a tool held in tongs. A blow from a sledge hammer made the impression. There was no regularity in shape, weight, or stamping, nor was the metal uniform in quality.

The mint could not furnish supplies fast enough, and licenses were issued to coppersmiths to assist in production. Naturally non-licensed persons began to manufacture, and adulteration with lead was so flagrant that when several tons of these coins were sent to England as old metal they were returned on account of their impurity, and were finally worked up into brass for local consumption. A "dub," if held in the flame of a spirit lamp, would before it reached red heat begin to discharge very fine jets resembling mercury; the lead, having reached its fusing point, burst from the copper with a force indicating a very high internal pressure.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangements with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

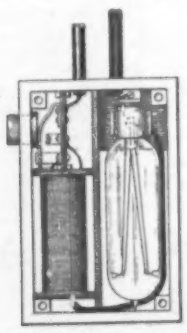
Pertaining to Apparel

SHIRT.—A. FISHER, 851 Hornaday Place, Bronx, N. Y. The invention relates to a convertable shirt, the object being to provide a shirt adapted to present a rolling collar or an ordinary collar band. The invention is characterized by the elimination of the V-shaped notch in the folding band and by the elimination of the flaps on the inner side of the shirt.

SHOE HEEL.—E. S. HELWITH, 1129 E. 15th St., Brooklyn, N. Y. The object of the invention is to provide a practicable rubber heel pad which may be easily attached to or detached from the heels of leather shoes to soften the tread of the wearer, means are provided for causing it to adhere to the pavement and prevent it from slipping, also to enable the wearer to attach it to the shoe without the employment of screws or the like. It is especially adapted to what are known as French heels on women's shoes.

Electrical Devices

FUSE AND CIRCUIT TESTER.—L. D. JOHNSON, 391 Oak St., Portland, Oregon. The invention relates to a simple, safe, and reliable device for testing fuse plugs while in circuit with respect to all voltages within ordinary range. The device is one in which the terminals are



PLAN VIEW WITH FACE PLATE REMOVED

always in series with a coil having a known resistance and a lamp is employed for maximum high voltage, say for instance 600, means being provided to test for any desired lower voltage by varying the effect of the resistance coil. The device is very small, portable, and practically fool-proof.

SWITCH BOX.—C. M. SIEFFERT, address Sieffert Electric Co., 212 Syracuse St., Evansville, Ind. The invention relates to switch boxes for electrical wiring systems. Objects of the invention are to provide a switch box having means for its quick and economical installation to new as well as old work, and which is of simple construction, therefore cheap to manufacture.

ELECTRIC IGNITER.—J. KRANNICHFELDT, Cologne-Nichl-on-the-Rhine, Germany. The invention relates to an electric igniter comprising a flat insulating body cut out to form a fork-shaped end, a layer of electrically conducting material on each side of the body and the prongs of the fork-shaped ends and on each face of the body, and forming poles.

Of Interest to Farmers

FERTILIZER DISTRIBUTER AND PLANTER.—L. MEHLBERGER, Box 132, Easton, Pa. The particular object of the invention is to provide a drill attachment which includes a series of dropper tubes beneath a table. In order to permit seeds or fertilizer to be delivered to the dropper tubes an accurate series of outlet holes are formed in the table and nipples are provided on the under side of the table constituting hoppers, there being a hopper for each dropper tube, a revoluble distributing device sweeps the material over the table causing it to be distributed to the dropper tubes.

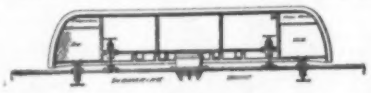
Of General Interest

CONTAINER FOR HYDROCARBON OILS.—G. E. PETERS, Rapid City, S. D. The object of the invention is to provide a containing can for hydrocarbon oils having means whereby to obviate the danger of filling a kerosene can with gasoline or vice versa, a further object is the provision of such means in the nature of a mechanism contained within the can which will be strong and comparatively inexpensive in its manufacture a float member is provided in the can in such manner that it will rise to permit the passage of kerosene, but is weighted not to permit gasoline the lighter hydrocarbon to pass into the can.

PRINTING DEVICE.—DE VERN C. HUFFMAN, Monticello, Ill. The object of the invention is to provide mechanism adapted for the use of merchants, shop keepers, market men and the like, wherein means is provided for entering the various items of a sales slip in printed characters on the slip, and wherein the total of the printed items is presented at the close of the operation, in order that it may be entered on the slip.

GAS REGULATOR.—F. J. MEYER, 20 W. Noble Ave., Oklahoma, Okla. The object of the invention is to provide mechanism for use in connection with pressure operated valves for controlling the flow of gas, for automatically increasing the pressure of gas during the time of largest demand, the device consists of a pressure control diaphragm operated valve for controlling the flow of gas through a pipe line, means for reducing the pressure on the outer face of the diaphragm with the increase in velocity of the flow through the pipe line.

SUBMARINE LIFE BOAT.—ST. CLAIR LEWARK, Mamie, N. C. The invention relates particularly to a surface boat attached to a submarine or under-water boat in such a manner as that it may be readily and quickly detached, and



SHOWING LIFE BOAT IN OPERATIVE CONNECTION WITH A SUBMARINE

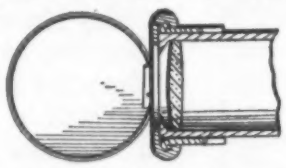
of such construction that when detached it will promptly rise to the surface of the water, the life boat having means to prevent it from sinking and to maintain it in upright position for independent use.

COMPOSITE RUBBER HEEL.—W. E. MACKENNA, Elmwood Ave. cor. E. 5th St., Brooklyn, N. Y. This invention relates to composite rubber heels, the object is to provide an air cushion which presents a bulging, yielding, wearing surface and which is substantially immune to puncture. The composite heel may be secured to the permanent heel, but preferably the inner face of the composite heel is provided with a recess tapering rearwardly, the sides of which are undercut to engage the raised flaring sides of a plate which has a taper similar to the taper of the recess. The plate is anchored to the permanent heel.

METHOD OF MAKING BROOMS.—O. B. WEIR and G. W. POWERS, care of Allen & Allen, 22 Brinkerhoff St., Plattsburg, N. Y. The invention has in view to form an essentially seamless clamp which will provide a substantial socket for the handle and have effective clamping engagement with the latter, in addition to its clamping and protective relation to the broom corn, whereby the clamping of the broom head, the welding of the clamp, the insertion and securing of the broom handle, and the formation of the handle socket may be carried out without appreciably changing the broom corn.

CIGARETTE HOLDER.—M. S. MACK, 15 Maiden Lane, New York, N. Y. This invention relates to cigarette holders characterized by the provision of means for automatically ejecting cigarettes from the holder. The device comprises a tubular housing to receive a cigarette, a mouthpiece, a plunger having a collar at the rear end fitting snugly into the housing, a coil spring for moving the plunger, the housing having a cut-out adapted to engage the spring to render the coil spring inoperative, a shield covering the cut out, a button on the shield and a stop for the plunger carried by the shield.

LENS-SHIELDING ATTACHMENT FOR CAMERAS.—B. M. TAKAHASHI, Harlowton, Mont. The invention relates particularly to a lens shielding attachment for use with photographic lenses, the object being to provide a simple readily detachable device in the form of a



LONGITUDINAL SECTION THROUGH LENS BARREL SHOWING DEVICE MOUNTED

circular opaque disk, which in its attached operative position upon the camera may be readily adjusted by the operator to shield the lens from light rays in any direction, the disk is supported by a sleeve fitting the barrel of the lens.

TOOTH BRUSH HOLDER.—J. A. KELLER, 216 W. 69th St., New York, N. Y. The objects of the invention are to provide a sanitary holder for tooth brushes, whereby the brush heads will be protected from contamination by dust or by splashing water when the device is set up as a bathroom fixture, to provide a holder in which a number of brushes may be held in small space, and to provide for entering and removing the brushes with facility.

FOUNTAIN PEN.—B. T. NEDLAND, Hillsboro, N. D. The invention has for its object to provide a fountain pen with a feeder in the form of a hollow tube and which has at its inner end a valve seat which may be closed by a valve. It is possible by this means to absolutely seal the feeder when the pen is not in use. Another object is to so construct the plunger that leakage at the rod and around the plunger may be prevented.

SAFETY PIN.—A. K. MASSA, 1280 3d Ave., New York, N. Y. The object of the invention is to produce a simple and inexpensive pin provided with spring-actuated catch which will retain the end of the pin and prevent an accidental disengagement of the same from the hook on which the catch is provided, this catch has a flat surface which rests against the straight side of a spring which is located in a slot, the slot is bridged and the spring has a recess for engaging the bridge whereby the spring is maintained in position.

MOUNTING FOR LENSES.—G. H. LOFLAND, 708 56th St., Brooklyn, N. Y. Among the principal objects which this invention has in view are to avoid breakage of lenses when mounting them in handles. Lenses are sometimes irregular in shape and dimension, for this reason the invention provides means of connecting the ends of the bands adaptive to these conditions, and means for holding the ends in juxtaposition and for exerting a closure strain upon the band.

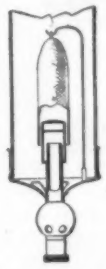
WEEDING IMPLEMENT.—H. W. HALES, Ridgewood, N. J. The invention relates to a weeding tool made of a single piece of spring wire having a portion doubled up to form a shank of two members arranged side by side, the shank fitting into a handle having a bore, the shank members terminating at their outer ends in angular prongs, fastening means are provided on the handle to adjustably secure the tool, which may be used on handles of various lengths.

CONDENSATION SASH FOR SHOW WINDOWS.—W. P. FRANCIS, 83 Marietta St., Atlanta, Ga. The invention has for its general object to simplify the construction of store fronts and show windows so as to afford an effective drain for the condensation on the glass, this is accomplished by the construction of a bottom bar for the window frame which embodies a gutter for the collection of condensation and also means for effectively supporting a plate glass.

UMBRELLA.—I. SONNENTHAL, 1531 Southern Blvd., Bronx, N. Y. Among the principal objects of the invention are to reinforce the braces of umbrellas, to furnish struts, the struts being adapted for assuming automatically the preferred service position, to provide a lock for preserving the relation of the braces and struts independently of the rics of the umbrella and to provide a simple means for raising and lowering the umbrella.

EGG SEPARATOR.—A. WICKE, 2306 Broadway, New York, N. Y. The invention relates to kitchen articles and has particular reference to means for separating the white from the yolk of an egg. An object is to provide a device which is simple in construction and thoroughly sanitary, which comprises an unperforated rim structure, a yolk receiving shelf secured with the rim, and a series of spaced parallel bars extending from the shelf to the opposite side of the rim.

GAS LIGHTING SYSTEM.—M. P. SMEDES, address Albert A. Sneller, Reeman, Mich. This invention comprises a threaded nozzle for engaging the pipe, a cylindrical threaded portion and a tapering plane portion, at its lower end a spherical



A SIDE VIEW OF THE BURNER

enlargement provided with a series of air inlets, a cap is connected with the cylindrical portion of the casing, the cap having a perforated top, a screen, and a reduced portion which fits closely to the cylindrical portion, the mantle being supported by the usual holder.

RAZOR STROPPER.—B. TROSKY, 477 13th St., Brooklyn, N. Y. A specific object of the invention is the provision of a blade holding device which embodies a plurality of blade clamping hooks, one or both of which are movably mounted the hooks being normally urged toward each the by spring means, whereby the hooks will firmly grip a blade, the hooks being mounted on a support which is in permanent cooperative relation with the stropping rolls.

CHAIR FAN.—T. B. LESZCZYNKI, 1413 Emma St., Chicago, Ill. An object of the invention is to provide a fan to be supported above a rocking chair whereby a slight movement of the

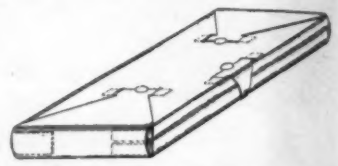
SIDE VIEW OF THE DEVICE AS APPLIED AND DETAIL VIEW

chair to which the device is connected will cause the fan to operate. A further object is to provide a clamp which may be arranged to hold a fan support or umbrella, as occasion may demand.

REGISTERING DEVICE.—P. BRASHER, 290 Willow St., New Haven, Conn. The object of the invention is to provide a registering device more especially in determining the qualities of any individual designed to mechanically assist an analyst by certain evident visible, physical characteristics by observing color, form, size, structure, texture, and proportion. The device consists of a series of guideways arranged one alongside the other, slides one for each guideway and adapted to be shifted therein, each slide having a positive and a negative set of indicating characters representing mental qualities, the slides being normally in inactive position in one end of the guideway and being adapted to be shifted in the guideways into active reading position.

DETACHABLE DEVICE FOR AERATING LIQUIDS.—A. J. PARKER, Port Pirie, South Australia, Australia. The invention is more particularly applicable for the aeration of liquids by means of carbon dioxide or other chemicals contained under pressure in small cylinders commercially known as sparklets, the principal object being to provide a device which can easily be operated and can readily be applied to the neck of almost any class of bottle now in use, nearly all such bottles having a rim near the extremity of the neck.

PACKAGE.—J. S. YEGASON, 258 5th Ave., New York, N. Y. The object of the invention is to provide a package arranged to hold folded pieces of textile materials of delicate texture such as diaphanous fabrics of silk, cotton, and the like, without producing a longitudinal crease, and to



PERSPECTIVE VIEW OF THE LOCKED AND SLIT PACKAGE

protect the folded piece against dust or being soiled while handled, shipped or stored. Another object is to enable the manufacturer to dispense with the reeling of the piece after it leaves the finishing machine, and to dispense with the tying tapes now generally used.

Hardware and Tools

CAN OPENER.—J. E. CHASE, care of Intn. Milk Products Co., 716 Eastern Ave., Schenectady, N. Y. The object of the invention is to provide a construction for quickly and easily opening milk cans without injury to the can or without spilling the milk. The device comprises an arch member formed with extensions and a pair of levers pivotally mounted on the arch members, the levers being so positioned as to have the lower ends project beneath the edge of the cover of a can so that when the levers are pivotally moved downwardly the ends will raise the cover.

HOOF KNIFE.—H. JOHNS, R. D. No. 1, Mainesburg, Pa. The invention has for its object to produce a hoof knife by means of which all the operations necessary to be performed in the trimming of a horse's hoof preparatory to shoeing may be accomplished. The knife comprises a handle having blades extending from the end in opposite directions and in the plane of the handle, the ends of the blades being bent over upon the bodies in spaced relation.

Machines and Mechanical Devices

SHAFT COUPLING.—W. J. FRANCK, Highland Park, New Brunswick, N. J. The invention has for its object the introduction of a coupling arranged to permit of quickly coupling the adjacent ends of alined shafts together. In order to accomplish the desired result a sleeve is made in sections and adapted to fit on to the ends of the shafts to be coupled, the sleeve tapering from the middle to the ends and the tapered portion having threads of which the innermost gradually diminish in depth, and nuts screwing on the threaded sleeve portions and having flaring entrance ends screwing on to the reduced threads.

ATTACHMENT FOR TYPEWRITERS AND OTHER MACHINES.—W. T. MACDONALD and B. W. SCOTT, 703 First National Bank Bldg., San Jose, Cal. This invention is applicable to key-operated machines generally, such as typewriters, typesetting machines and the like, in which a carraige is caused to travel and then return to the initial point. More particularly the invention relates to means for automatically returning the carriage by a spring motor in which power is stored by the operation of the keys and incidental to the normal functions of the keys in performing the operations of printing, spacing or the like.

CENTRIFUGAL CASTING MACHINE.—G. C. CLARK, 1107 No. Main St., Detroit, Mich. The object of the invention is to provide a centrifugal casting machine arranged to effectively compact the grains of copper or other metal used with a view to increase the density and cohesion of the grains and thus produce cast rings of high tensile strength. Another object is to allow of rotating the casting box at a high speed and to prevent scattering and spattering of the molten metal while delivering it into the rotating casting box.

Prime Movers and Their Accessories

CARBURETER.—L. F. STUPECKY, Manitowoc, Wis. The object of the invention is to provide a carbureter arranged to automatically control the mixture of air and gasoline vapors according to the speed of the engine thus insuring the formation of a correct explosive mixture under varying speeds of the engine. In order to accomplish the result, use is made of a needle valve provided with an auxiliary air supply normally closed by the liquid fuel in the well of the carbureter and opened on a rapid consumption of the liquid fuel in the well in case the engine is running at high speed.

Pertaining to Recreation

GAME.—F. G. GRAVESTOCK, 1040 Cole St., San Francisco, Cal. The invention relates to a combined educational chart and game. An object in view is to produce a chart showing a country and the subdivisions thereof with certain other information and means associated therewith for use as a game whereby the subdivisions and other information relating to the country will be automatically learned during the playing of the game.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Where England Gets Her Women Workers

(Concluded from page 520)

although raised in some branch of industry utterly foreign to a machine shop, in a very few weeks of our shop training have made such pieces as milling cutters, machine reamers, arbors, etc. One man who had been an attendant in a Turkish bath is now in our production department, running a horizontal milling machine, and he is a better man than we can get through our employment department under existing conditions.

"When an opening in the shop presents itself, the chief instructor selects the man from the school whom he thinks best fitted for the place. The length of time in the school has practically no bearing. Some men in a few days, due to natural intelligence or matured judgment, are better fitted to take jobs as shop operatives than are others not so fortunate. In some cases men have spent only two or three days in the school; in others they have had to remain several months. The average time has been about three weeks."

The workings of this general plan are not confined to any one country or class of employees. It is, in fact, the method by which England has most successfully qualified her millions of women workers. We are all familiar with the fact that women have been introduced in large numbers into the British factories and shops; but many of us have had an erroneous idea as to the basis on which they are employed.

The term dilution of labor is perhaps an unfortunate one to apply in this connection. The impression which it conveys is rather that of a large number of unskilled workers hovering about a small nucleus of skilled men, of working processes so modified that this unskilled body can relieve the high-class men of most of the work and so stretch their output, or of machines so altered that a lot of unskilled men can operate them under the directing eye of a single skilled man.

Now, it is true enough that dilution has in many, many cases taken this direction. But the great results which England has attained with women workers have not been reached in this way. The women have actually replaced the men. They are running the machines which the men used to run, with no more supervision from some superlatively skilled overseer than any good union man would expect from his foreman. The women have simply taken hold and become skilled workers to replace those gone away.

The means by which this has been accomplished, and so rapidly, is the factory school. The apprentice system is defective in the great fundamental that it mixes business with instruction. The business must not suffer, so the instruction does; it is a matter of years for an apprentice to learn what he might absorb in a few weeks of undiluted instruction.

Of course, England has had to feel her way in this matter. Some employers have placed the women right in the shops, as helpers or feeders or sometimes merely as observers, expecting after an indeterminate period that they will gradually become competent to run the machines themselves—a sort of apprentice system, in other words. The same objections already mentioned to mixing production and instruction obtain here. Others have been prejudiced against the women, either from the start or by reason of some unfortunate experience in attempted combination of instruction and production. Many such have tried actual dilution with unskilled men and boys, somewhat on the plan described above in connection with our hypothetical definition of the term. But at this late date the thing has got to the point where actual comparison may be made; and cold hard figures demonstrate that neither in actual dilution of the factory personnel by men who never get the advantages of instruction unmixed with the drive of production, nor in outright replacement of the skilled hands by others who are expected to acquire their skill after their introduction to actual work, is it possible for boys under army age and men over it to make a showing approaching that of the women who have passed through the factory school.

This is not difficult to understand. The writer has had a good deal of experience teaching elementary algebra to students in their thirties and forties, and does not hesitate to say that the chance of a person taking on successfully a brand new habit of mind at such an age is a remote one. This factor makes the effort to convert into a machinist a man of forty-odd who has spent all his life with a shovel a thankless one under any circumstances, and doubly so when he is not given the advantage of explicit instruction and undivided attention. And any foreman knows how hopeless it is to expect decent mechanical execution from a boy who has not grown up mentally.

Neither of these handicaps operates against the woman who goes to school in the factory to learn machine operation. She is seldom too young to do good work, she is seldom too old to learn a new game; and above all she has the advantage of deliberate instruction from a person chosen because of ability to instruct. Her mind and hands, in the bargain, are perhaps a bit more adjustable than those of her brother. Accordingly, it need occasion no surprise when we learn from England that the factory school, in its complete working out an American idea, has caught on tremendously on the other side of the water, and that English manufacturers are coming to rely, with more and ever more confidence, upon its ability to turn out girls and women who can do any job of machine work that is not actually beyond their physical strength. The shipyard shown in our pictures is but one case out of a multitude. It is believed that here lies the permanent solution of the problem of finding satisfactory workers, either male or female.

Frozen Fish as Food Supply

THE business of freezing and storing fish, and the commodity itself when properly handled, received the commendation of the United States Department of Agriculture in a recent publication, Bulletin 635, describing an investigation recently made of the industry. It is pointed out that freezing and frozen storage will hold fish for many months in the condition in which they were received but will not repair deterioration due to previous heating or mishandling. Properly frozen fish reach the retailer in excellent condition. He should keep them hard frozen until they are sold. The practice of thawing fish by warming or in water greatly lessens their food value and flavor. Chemical analyses show no significant changes in fish held 27 months.

Pitcairn Island Shipbuilding

EARLY in 1916, the people of Pitcairn Island, an islet of two or three square miles far out in the South Pacific, 1,200 miles east of Tahiti and 900 miles west of Easter Island, with a population of about 200 descended from the mutineers of the "Bounty" and the Tahitian women whom they took to Pitcairn in 1790, set themselves to build a schooner. They had to forge their own nails out of any scraps of old iron available and the work was done under most primitive conditions, but the schooner sailed on her maiden voyage in January, 1917, and made the trip to Tahiti and back in safety, in spite of the fact that a cyclone was met on the way. By this means letters which had been lying at Tahiti for over three years waiting for some way of communication reached the island.

Dust Cover for Bath Tubs

THE difficulty of keeping the bathtub scrupulously clean is one which is familiar to every housewife. The frequent opening of bathroom windows for airing purposes is certain to result in the undoing of considerable labor.

A neat, serviceable cover made of a fabricated sheeting has been found an excellent preventive for this condition. The cover is made large enough to fit under the roll edge of the tub. A drawstring holds it in place. This cover can be placed in position or removed in a few seconds

The Airplane Propeller

(*Concluded from page 523*)

may cause a serious accident. Propeller blades must be straight; they must have an equal length to within a sixteenth of an inch; they must have an equal thickness in both blades at all points—in other words the non-thrust side of the propeller must have identical camber on both blades, otherwise they will not equally resist bending and centrifugal force stresses; they must have absolutely tight joints; they must be as smooth as they can be made; they must be mounted absolutely true on the shaft; and they must be cared for like a sick baby if they are to be efficient.

Propellers must never be stored in very damp or very dry places. Wood must have a certain amount of moisture in it to be strong—dry rot sets in when all the moisture is removed. Damp wood swells and loses strength. Propellers are never stored standing on edge or hung horizontally—they are hung vertically against a wall, that they be subjected to the least bending stress from their own weight.

The manufacture of propellors, with all these things in mind, is by no means a simple operation, as may readily be guessed. It has been found that no single piece of wood produces as strong a propeller as one "built up" of laminations—a lucky find, indeed, since single planks of the required size and thickness and absolute absence of flaws would be hard to secure. The wood is laminated by gluing under very heavy pressure—a pressure so heavy that the film of glue remaining between the absolutely true surfaces of the boards is of microscopic thickness. Such a laminated "blank" is used to build the master propeller, which requires the most painstaking care in its manufacture. For it is hand work pure and simple. The propeller is literally whittled out of the blank by hand—a measurement, a fitting to a template, a calculation, with almost every chip.

Prior to the war, all propellers were made by hand, not only master propellers but those for actual use. Some pilots today won't fly with a machined propeller, but tests have demonstrated that this is purely a fancy—the machined duplicate of the master propeller rarely requires any appreciable hand work to make it perfect, and when it does, the cause is found in the wood itself and a lack of uniform density, rather than in any failure of the duplicating manufacturing operation.

This operation, by which several propellers are made at once, uses the same principle that is employed in making gunstocks. The master propeller is rigidly fastened to a framework, and above and below it, to the same frame work, are fastened laminated blanks, roughly hewed to the semblance of propellers. The workman handles a tool which is a part of a peculiar mechanism working on the pantograph principle. This tool and its position controls the position of cutters, revolving at high speed, which shape the blanks. As the workman runs the pointer over the surface of the master propeller, the cutters work similarly over similar positions of the blanks. They cannot cut too deeply, because they cannot cut further into their blanks than the pointer will go into the master propeller.

Once fastened to the frame work and it takes only ordinary skill to operate the pantograph tool. But when it comes time to reverse the blanks and cut the other side, great skill is required to see that the now half-finished propellers are put in absolutely identical and parallel positions. The least deviation from an exact parallelism with the master propeller will cause errors sufficient to destroy the propeller being cut.

When the cutting is finished, the propellers are hand rubbed to a smooth dull finish, and then tested, tested, tested. They are tested for length, balance, width, camber, pitch angle; they are tested before varnishing, and all over again after varnishing. Finally, they are tested by being run at a much greater speed than they will ever have to sustain in the air, for the "factor of safety" of a propeller is most difficult to calculate, and no pilot feels safe with a written guarantee only—he wants to know that, if his propeller is to run at 1,200 r.p.m. it will stand 1,500 or 1,800 without flying into splinters.

By no means all propellers are made with the pantograph machine. American manufacturing methods have developed this device, and turned some piano factories into propeller factors with amazing results—amazing as to speed and accuracy. Piano factories and piano workmen lend themselves most readily to what is seemingly so great a change, because pianos are largely made of wood, and the piano workman, a cabinet maker raised to the nth power, is accustomed to working to a very high degree of accuracy. Laminated wood, glued under pressure, is to him a familiar material.

But many special propellers for special planes are still whittled out by hand—indeed, all experimental propellers must be so made. And experimental propellers are constantly being made. The wind tunnel, court of last resort of the aerial designer, is in constant use for determinations of propeller efficiency—Eiffel's experiments, indeed, are those which have seemed to demonstrate the soundness of the "similitude of propellers" idea.

But the making of propellers is by no means as yet a finished art. The constant compromise between weight, size, length, thickness, camber, pitch, speed of revolution amount of allowable bending stress under action, finish, metal-tipping or no tipping, etc., gives opportunity for a thousand variations in propeller shapes and manufacture. Like the plane itself, the propeller is in a chrysalis stage. As the aluminum-painted, blunt-ended, almost spoon-shaped propellers of the first Wright machine, or the still earlier "windmill" propellers of the Langley machine are utterly unlike those smooth, softly-flowing-lined propellers of today, so doubtless will the propellers of the future differ from those of the present.

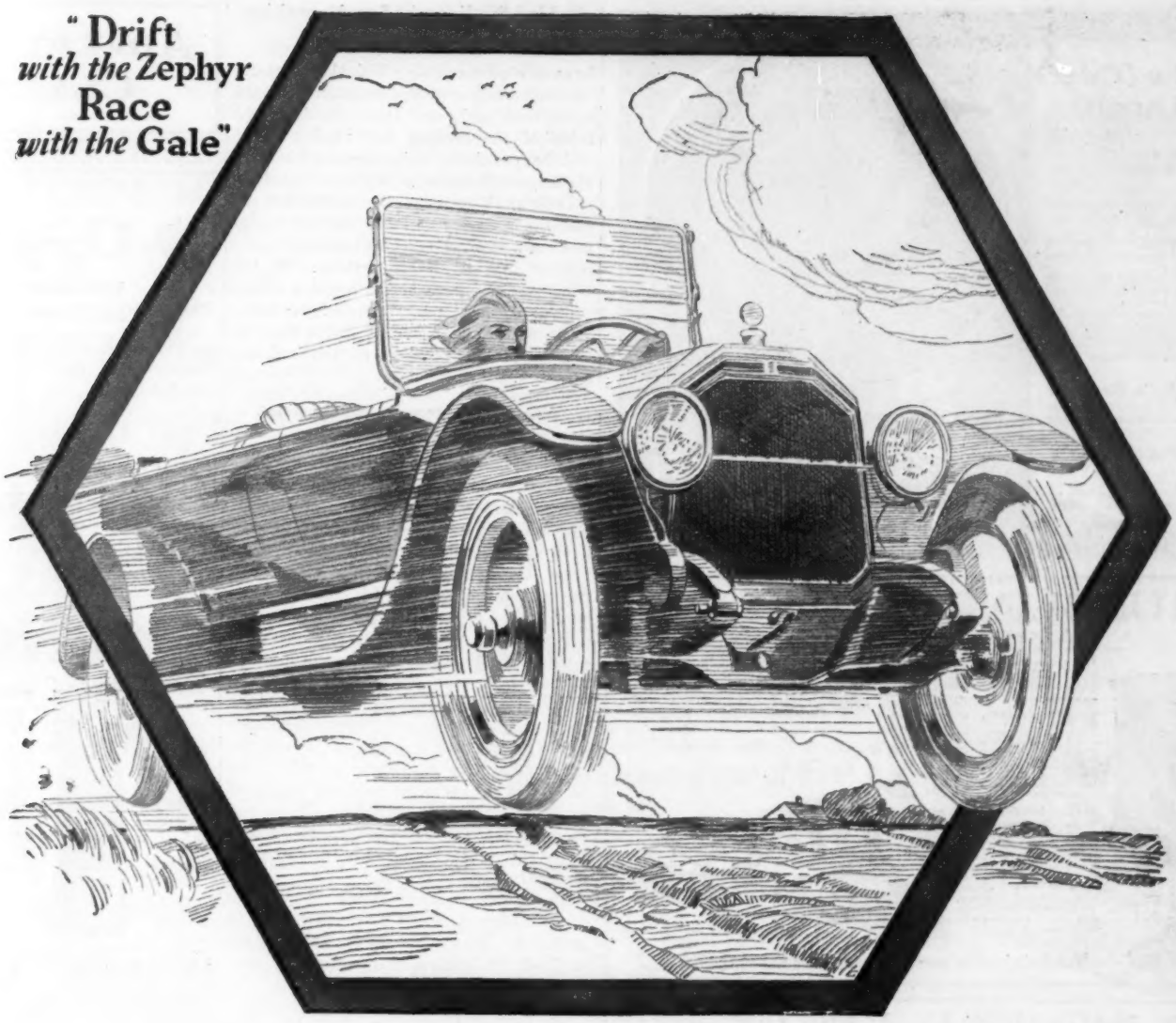
Meanwhile, experiments go ceaselessly onward, seeking always the goal of greater efficiency—a greater proportion of the available horsepower of the engine expressed in horsepower in thrust. At the present, a propeller which takes 100 horsepower to turn at a given revolving speed and delivers 75 horse-power in thrust is a fair propeller. More is a good propeller. Much more is the propeller of the future. If we ever succeed in getting all the available horse-power of the engine into thrust, we will have gone a long, long way towards solving that other great problem of aviation—how to add weight, to gain safety and carrying capacity, while retaining the present standards of lift, speed and manageability.

An Electric Furnace for Brass

THE Bureau of Mines announces the perfection of a type of electric melting furnace that may be revolutionary in the making of brass. Patents on this furnace, known as the Rocking electric furnace, have been taken out by the bureau and have been assigned to Secretary of the Interior Lane as trustee. Free licenses to operate these furnaces under the patents, can be obtained by applying to Van. H. Manning, Director of the Bureau of Mines.

The new furnace, which it is claimed will reduce the important losses in brass melting, is the result of five years' experimentation by H. W. Gillett, chemist of the Bureau of Mines, in coöperation with the laboratory of Cornell University, and the American Institute of Metals.

Up to the present most brass has been made in costly crucibles of imported clay and graphite. Since the war it has been impossible to obtain the imported materials for crucibles, and manufacturers have had to put up with crucibles of much poorer quality, and at a cost many times that of pre-war prices. With the huge tonnage of brass needed for war purposes, such as shells for cartridges, manufacturers have been anxious for a solution of the crucible problem. The bureau states it is inevitable that the next few years will see electric furnaces largely replacing crucible furnaces and that there will be a development comparable to that seen in the steel industry.



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The wider range of speeds a car is capable of, the more perfect the cooling system must be.

This is why you find Harrison Radiators on cars whose motors respond so easily, quietly, to each gentle pressure of the accelerator.

Harrison construction embodies all the requirements of a cooling system—big free air passages, cool, easy flowing water circulation, lightness of weight, durability.

You will always observe motor flexibility in cars equipped with a

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Behind the Scenes of an Exposition

(Concluded from page 525)

have erected carousals which they operate. Yet this merry-go-round magnate is on the scene both early and late. He is in the thick of the hardest and dirtiest work, and he positively enjoys every bit of it. He knows his carousals as no one else does.

Long ago Dentzel's father established the carousal business and made his own equipment in a small shop which has steadily expanded into a sizable factory. So the hand-carved figures and trimmings of the present carousal were made in the home plant, and then shipped by motor truck to the exposition because of the railroad situation.

Where the Showman and Architect Cannot Agree

In keeping with the best traditions of the carousal world, the animals in this case are bedecked in the most vivid hues imaginable, with here and there a relieving dash of gold or silver or bronze. Certainly, they are well made, even down to life-like glass eyes. Among the specimens of this man-made zoo is a flock of blue ostriches.

Everything would have been perfectly satisfactory to all parties concerned had it not been for those ostriches. The architect in charge of the exposition took great pride in the carousal building, because of its commanding position. Forty-two thousand dollars were spent on this structure when the architect suddenly happened to "spot" the blue ostriches. Then and there his interest in the enterprise suffered a severe reverse and his temperament received a serious shock.

The good architect tried to tell his carousal friend about the folly of blue ostriches. Why not make the animals true to life? he argued. The carousal man came back with the statement that the populace simply reveled in blue ostriches, pink horses and green cats, all bedecked in their Sunday best. Argue as they would, neither side could be convinced that it was wholly or partially wrong.

All of which serves to illustrate the difference that always exists between the artistic architect and the business showman. Time and again in this particular exposition the architect and the showmen have been at odds, because the architect rarely appreciates the essentials of showmanship. He does not see the problem from his client's viewpoint.

But the showman, on the other hand, has a sense of the artistic when it does not interfere with business. Evidence of that is not wanting in the New York International Exposition, for the buildings are attractive and imposing, and well set off with trees left standing on the old Astor estate, and others planted according to plan. Thus at the center of the ground, where the Tower of Jewels is to rise to its stately height of some 65 feet, all a-glitter both by day and by night with 10,000 cut-glass variegated jewels from the San Francisco Exposition, there are numerous tall trees with an abundance of foliage. They lend to the buildings a pretty touch which cannot be emulated by human endeavor—and the showman has certainly exhibited great sagacity in leaving these trees standing, despite the room they take up. Indeed, under these trees there is always a cool breeze blowing from the west, which, thanks to the luxurious foliage, is not neutralized by the sun's hot rays.

Buildings are rapidly nearing completion on every side. There is the Club de Papillon, a stone structure with long and wide balconies and pavilions where diners will dine in the open air while being entertained by a cabaret performance of the Broadway stamp. There is the House of Nonsense, where the populace will be given all those thrills and surprises for which it travels many miles on a hot summer's day. There will be bellicose attractions in keeping with the present military spirit, such as "Over the Top" and "No Man's Land," as well as reconstructed Jerusalem. An imposing building is the bath house, which will contain over a thousand dressing rooms. Across a large expanse of water a hotel is being

rushed to completion, with a popular priced restaurant on the main floor, a large ballroom, a roof garden, and a cafetaria in the basement. Near at hand is the Bronx River, of which full use has been made, including not only its charming vistas snatched in the ride on the scenic railway, but also to furnish water to the Venetian canals where sluggish but graceful craft will carry their human freight on pleasure bent.

But the cardinal attraction is to be the bathing pool. Already it is practically completed, with its concrete sides and floor enclosing an area of 350 feet by 300 feet, or sufficient space to contain 2,500,000 gallons of water. The beach is confined between low concrete walls, and many a load of pure, white sand is to be transported there. From the beach the floor of the pool gradually slopes down from zero to four-foot depth, and life lines are provided for the more timid swimmers. Beyond that point the slope is rapid until a depth of 10 feet is reached. At the deep end of the pool there will be the usual collection of diving platforms, springboards, chutes and other things which delight the daredevil swimmer, not forgetting the wave-creating equipment—12 huge wedge-like wooden pontoons operating in concrete recesses, which will pound the water and cause long rollers to travel 300 feet across the pond to the beach out front. The pontoons are electrically-driven in two sets, through long crank shafts, gears and connecting rods.

Building Mountains Without a Plan

We prophesy that the first thing to catch the eye of the visitor will be the decorative effect of the pool background. There is to be a waterfall 65 feet high, over which great volumes of water will pass into the tank. The water will be ensconced between two mountain ranges on whose slopes Japanese high-arched bridges and white-railed foot paths add a touch of enchantment. Water will trickle down the mountain sides, and here and there tiny waterfalls and water wheels will give an animated touch to the characteristic Japanese scenery. Over the trails the bathers will pick their way to a grotto back of the sheet of falling water, there to enjoy the coolness of the man-made cave and to grope through the rock-bound twists and turns.

Now the architect of blue-ostrich antipathy was supervising the work of building the tank and background until his services were required in a special branch of the U. S. Army. The gap thus created in the exposition personnel was a serious one; for the supervising of hundreds of men calls for something else besides executive ability. Emergency measures were not entirely successful, so C. Frank Stillman, the electrical engineer of the exposition, volunteered. And, we are told, he made good. Today he is supervising all the work, including the erection of the Japanese mountains.

So there is no harm in betraying a secret, even though we be within hearing of certain members of the engineering fraternity. The truth of the matter is that when Mr. Stillman took over the work, there was only the general idea for the pool background. Time was limited, and he set the men to work without any detailed plans and blueprints as called for by orthodox engineering methods. Each day he told the men what to do next, and the task was planned as it proceeded.

The mountains are only surface deep, of course, yet very effective. First a huge framework of wood was erected, suitably braced at the rear, and then subsidiary framework nailed on, with sticks protruding in every direction to give shape to the peaks and jagged ends. Over this mass of wooden framing, wire screen of coarse mesh was nailed. Cement hands then set to work smearing rocklike cement over the screen. The final stage was the finishing work, consisting of shaping the surface and dashing on cement in little lumps to simulate rough rock. In finished form it requires dynamite to damage the rocky face!

Before leaving the bathing pool it is of some interest to study the water supply question, which, we are informed by the publicity man, has received the most careful consideration. Water is to be pumped from the Bronx River about half a mile below the grounds, at a point where there is an 11-foot tide. The intake pipe will be five feet below low tide, so that there will be little opportunity for sucking in surface grease and scum, driftwood and other undesirable material. Passing through the pipe line the salt water will empty into a receiving basin or reservoir back of the pool and the mountains. In this V-shaped cement-lined basin the water will be permitted to remain so as to have impurities settle to the bottom. As the water is required it will be passed through chloride filters of which six have been installed, with a combined daily capacity of 3,000,000 gallons.

When the water finally passes into the tank over the 65-foot falls, it will be as pure as scientific knowledge can make it on a large scale. The falls will aerate it and fully restore that invigorating property which the filtering process impairs to some extent.

Art and Plaster

The divers attractions of the exposition have led the writer astray, to be sure; for the original intention was to tell mainly of the art of surface beauty as practiced in the exposition business. So we now must go to a low building beneath the elevated structure of the railroad passing through part of the grounds, and learn something about the plasterer and his art.

There is not much equipment called for in the plaster business. The plaster shop reminds one of Bolshevist Russia: chaos is rampant to the point of appearing most amusing; but unlike the accomplishments of Bolshevism, the plaster shop's chaos is but an unavoidable means to an end, and there pours forth a constant stream of plaster objects. One sees many plaster-of-paris bags about; here and there barrels filled with white liquid; a broken bale of hairy material which proves to be shredded fiber; wooden molds, gelatin molds and other types of molds standing about, smeared with plaster and hair, and looking quite forsaken; and here and there finished and partly finished pillars and arches and plaques.

There is little labor connected with the casting of a pillar or arch. The mold is a sectional affair, which is assembled and then greased to prevent the plaster from sticking. The liquid plaster is poured into the mold to the required depth, after which the fiber is spread over the liquid. The hairy pile is then pressed down into the liquid mass and covered with more liquid plaster. In about twenty minutes the plaster is set or hardened, but it requires about an hour or more before it can be safely handled. The mold is taken apart and the casting removed. It is stood up in a corner or taken out and laid on the grass to dry in the sun. The fiber, which does not show from the front, serves as a binder for the plaster and greatly adds to the strength of the structure.

Certain other articles are somewhat more difficult to cast. For instance, plaques and similar ornaments call for a gelatin or glue mold. First the pattern or "master" is made in clay or wood by a skilled worker, after which it is surrounded by a shell with space between to form a mold, so that liquid gelatin or glue can be poured in and allowed to solidify. In this manner an accurate glue mold is secured, backed with plaster and reinforced if necessary. As many plaster duplicates as may be desired can then be cast.

Sometimes figures are made in plaster by hand, with all manner of reinforcing members aside from the fiber. That is when we realize that the plasterer is something more than an artist—he is a mechanic. The figures are generally copied from a miniature in clay.

At the Bronx place they certainly have the plaster work down to a Ford-like process. The pillars, ornaments, arches and the more common plaques are standardized and turned out on a quantity-production basis. As fast as they are required they are ready for the carpenters and mechanics, who nail them into place.

Box-like structures are converted into California mission buildings; gloomy walls are broken up by attractive archways; unattractive doorways are enlivened by elaborate plaques—all while you wait and watch on.

A pleasant man with a true artist's Van Dyke, whom we afterward learn is the boss plasterer, volunteers the information that plaster work stands the weather well, provided it is properly weatherproofed with protective paints. Just so long as the paint coat is maintained intact and water cannot get at the vitals of the plaster, this material is as good as stone or cement. But it requires constant watching; and where cracks and open joints appear the workmen of the exposition will have to get busy. If they are on their job, the plaster ornaments will successfully withstand the elements and last many years.

The official opening of the New York International Exposition was originally set for May 30th, but it is quite likely that the real opening will take place about one month later. At any rate, soon the grounds will be thrown open to the public who will find much there of interest to them, whether they come for entertainment, education or business.

American Confectionery Abroad

(*Concluded from page 526*)

high-grade confectionery and have secured a very large share of the other grades. Many dealers in Hongkong now carry considerable stocks of American candy and some even carry American confectionery almost to the exclusion of other brands. Several firms have recently given standing monthly orders to American exporters. Boxed or tinned goods constitute the larger part of the business at present, but the demand is rapidly increasing for exports in bulk.

The trade has heretofore consisted, to a very large extent, of chocolate products, but a market for mixed candies of all sorts has developed recently. Confectionery packed in one-pound boxes, each encased in a tin box sealed with adhesive tape and wrapped in a special covering on which the nature of the product is indicated in both English and Chinese will usually meet with a ready sale. Imports of American confectionery into Hongkong during the year ending June 30th, 1916, were valued at $8,304, a very large increase from the preceding year.

Other countries whose imports of American confectionery are noteworthy, with the value of their imports for the year ending June 30th, 1916, are: Greece, $36,781; England, $564,228; Canada, $273,438; Panama, $70,179; Newfoundland and Labrador, $34,638; Cuba, $175,646; Dominican Republic, $49,282; Colombia, $51,201; Venezuela, $36,365; Australia, $80,789; and the Philippine Islands, $113,748. All of these countries, except Australia, showed enormous increases in the year 1915-1916 over the preceding year, many doubling or tripling their import, while Greece increased its figure over 1,769 per cent.

To Replace German Goods with American Products

A BELGIAN export organization with branch office in London and numerous agents in France, Belgium, Near Eastern and Belgian Congo is anxious to represent now and after the war American manufacturers of:

Ironmongery. Industrial substitutes and technical accessories. Leather imitations. Building and household requisites. Chemicals. Raw and by-products for various industries. Canned goods.

They are willing to purchase goods for own account, if necessary, and to purchase French and Belgian specialties for America. They would contemplate formation of a Belgo-American export company or European corporation with office and showrooms in Paris, Antwerp, London and Central Africa to promote American and Allied trade in Latin and Atlantic countries. They have wide experience in European showrooms, selling and advertising. English, French, Spanish references.

An Engineer's View of the Liberty Engine and the Airplane Program

By Charles F. Kettering*

President of the Society of Automotive Engineers

I FOUND to my surprise the other day that many people did not know that one of the Liberty Motors had ever been completed. The lack of appreciation by many people of what real manufacturing is, of what is necessary to produce things so essential as these Government standard designs, has caused a waste of much printer's ink and paper.

I am going to give you a very simple account of an incident in Dayton the other day. Two gentlemen from Chicago came there to see me regarding some business matters. Each of them had two sons in the Aviation Corps. They looked worried, and I said to them, "What is wrong with you fellows?" One said, "If you had two sons in the Aviation Corps, you certainly would be worried. We have no engines, airplanes or anything else. This confounded Liberty Motor is a failure, a great joke perpetrated on the American public. I am going to Washington." I said, "There is a train at three and another at eight; just skip the three and take the eight o'clock train." We went to an airplane factory in Dayton and came to one lone Liberty engine. He said, "My God! Have they got one done? Have you had this in a plane?" I said, "No, never had this in a plane." He said, "Why don't you put it in a plane?"

He walked about and finally into an aisle and saw about seventy-five Liberty engines in a row. He asked, "What are they?" I said, "Liberty engines." "Where did you get them?" I said, "The name-plates on them tell where they are from, some from the Packard Company, some from The Lincoln Motor Company." He asked, "How long have you been getting them?" "Right along." "How many have you had?" "Two hundred and fifty or three hundred." He said, "I was told in Chicago the other day they never made one of them." I said, "We can't control what you are told in Chicago; we can only take the engines as they ship them in." He went about and saw one of the airplanes and that we had actually built a machine. He said, "You can't get the engines off the ground." I said, "Partially true; you can't get them off the ground unless you run them." He asked, "How fast do they go?" I said, "That is a question. Would you like to ride behind one of these engines. I can't show you by conversation anything about it." He said, "I have never been up." I said, "You had better take your initiation right now. Here is a stop-watch. Just as you leave the ground press that and when you pass 10,000 feet press it again, and when you come back tell us." We sent him up and he came back Talk about a transformation. He was not the same fellow that went up at all. He had forgotten everything about being scared and being 10,000 feet in the air. He said, "My God, we got up 10,000 feet in a little over seven minutes." We said, "If you would like to take another ride, we want to show you how fast we can go." He said, "No, I don't care to go again, but my friend will go on this trip." The friend went up and we ran him over a measured course and showed him we were getting better than 135 miles an hour.

Those men went back to Chicago contented with their experience. They said, "Wait till we get back there; we want to see some of those fellows who have been telling us that we have no engines or airplanes." They had some facts they had gotten first-hand.

There are a few very important facts and here is a very simple one that perhaps you have not thought of. The Liberty engine cannot read; it has no ears; therefore it does not know anything about the criticism that is going on about it. Otherwise I do not know whether some of them would get off the ground. I think they would be too discouraged to try. But knowing nothing of the situation, they are doing admirably, and the engine today, as

*Extract from an address delivered before the Metropolitan Section of the Society of Automotive Engineers in New York.

near as I have been able to analyze it, knowing something of aviation engines, is as good as if not better than has ever been created.

It is being produced in quantities. They shipped the thousandth engine several days ago, only two companies having been in production. One of these has been in production for about sixty days. The Ford Motor Company has tested its first engine and put it through the official 50-hour test. The same thing is true of the Cadillac Motor Car Company and of the Buick Motor Company. The Marmon Company is, I believe, putting its engine through the test now.

It has not been a year since the first one of these engines was put together experimentally. It is a new product, a new order of things, which people are not familiar with. It is perhaps because we do not analyze these conditions, that so much criticism and gloom have spread over the country. There is only one thing that will answer the criticisms and that is the engine itself. But I think it will be very gratifying for you to know some of the simple facts. We can show you things in Dayton that would gladden your hearts and brighten your eyes. And Dayton is only one place of activity in this matter.

When I was coming down from Chicago the other night, two fellows were talking in the smoking compartment. One said, "I understand this plane they are making in Dayton can't get off the ground; a friend of mine was down there the first day they tried it." I said, "That is right, I was there." He asked, "Have they ever been able to get it off the ground?" I said, "Yes, getting an airplane off the ground is like the case of the fellow who bought the barrel of apples from an Irishman and said, 'No sir, I don't intend to buy any more apples from you, because the other barrel you sold me had a few apples on the top and the rest were worthless." The Irishman said, 'My friend, it is not my fault; you opened the barrel at the wrong end.'" The momentous occasion which was mentioned and of which an account was published, happened in this way; a manufacturer desired to try out some propellers. He sent four experimental ones. His letter read something like this; "I am sending you four experimental propellers. I don't believe the number one propeller will fly the machine, but it is very important that, if you get into the air, your record the revolutions per minute at which the engine is turning. I think the number four propeller will be perfectly satisfactory, but in order to get the data I need I am sending all four."

Now the men who unloaded the propeller boxes did not know anything about the letter; they unloaded them out on the field where they were going to make the test and the boys opened the one nearest the machine, which happened to contain the number one propeller. This propeller was tried on a plane, marked no good, and put back into its box. It had not run at a sufficient number of revolutions to make a flight worth while. The next propeller which happened to be lying there was number four, and a very nice flight was made with it.

This was the basis of all the comment. It was purely a matter of chance which box was opened first; like in the case of the barrel of apples. In any other industry you could have tried 50 propellers and nobody would have taken any notice of it, but here was a national issue.

There is one thing we ought to get into our heads, that I think we have not appreciated entirely, and that is the fact that if not a single mistake had been made in any one of the Government proceedings, we would have been delayed from three to four months in obtaining the amount of tools needed because of the congestion in transportation, in addition to the extraordinary demand. Some months ago I asked a leading automotive manufacturer connected with the aircraft production whether he expected to be able to get the tools he had to have. He said, "In the last ten years I have put over twenty-five million dollars into machine tools and there is not a manufacturer who is not going to give me what I want." He ordered his gear cutters and lathes and milling machines and what-not. When I saw him a few weeks later, he said, "Look at this sheet. Those are my delivery dates. Now don't you think I can get the stuff? I am an old hand at this game." That was all right until the Priority Board said, "These tools are needed more elsewhere." He got only a small percentage of the tools he expected within the specified dates. He endeavored to get thread gages and other articles, and the same thing happened. I saw him a few weeks ago and he had not received all his tools yet. There is universal delay in such things and it is always interpreted against the particular thing that the particular critic wishes to criticise.

The airplane products are coming along fast. There has been some delay on account of our inability to decide finally on machine gun equipment and types of bombing devices. While waiting until final decisions were received from the other side (the difficulty has not been all on this side; there has been a change of mind on the other side not infrequently), many a thing which was started has been stopped and then started again. We have had confusion on account of changes in specifications made here. There have been put into the great Governmental and industrial organizations thousands of people who have been unfamiliar with manufacturing methods. We have had that to contend with. That sort of thing is wearing away. It is becoming more appreciated that people who have spent all their lives in the shop really know something about it and that those who have been able to make things before are able to produce for the Government. We have cleared away a great lot of this preface to our book. It has had a lot of fly-leaves in it; but I believe we are right up to the reading matter now. Last week we shipped from the factory with which I am connected, 42 of the fighting machines with 75 per cent spares. When you ship four machines you really ship seven; so that if you ship 40 machines, that is really equal to 70 machines. That production is coming right along. We have done in our method of manufacture what all of our American aircraft people have done; it is possible to build aircraft today by the interchangeable method just as it is possible to make anything else, and that is being done.

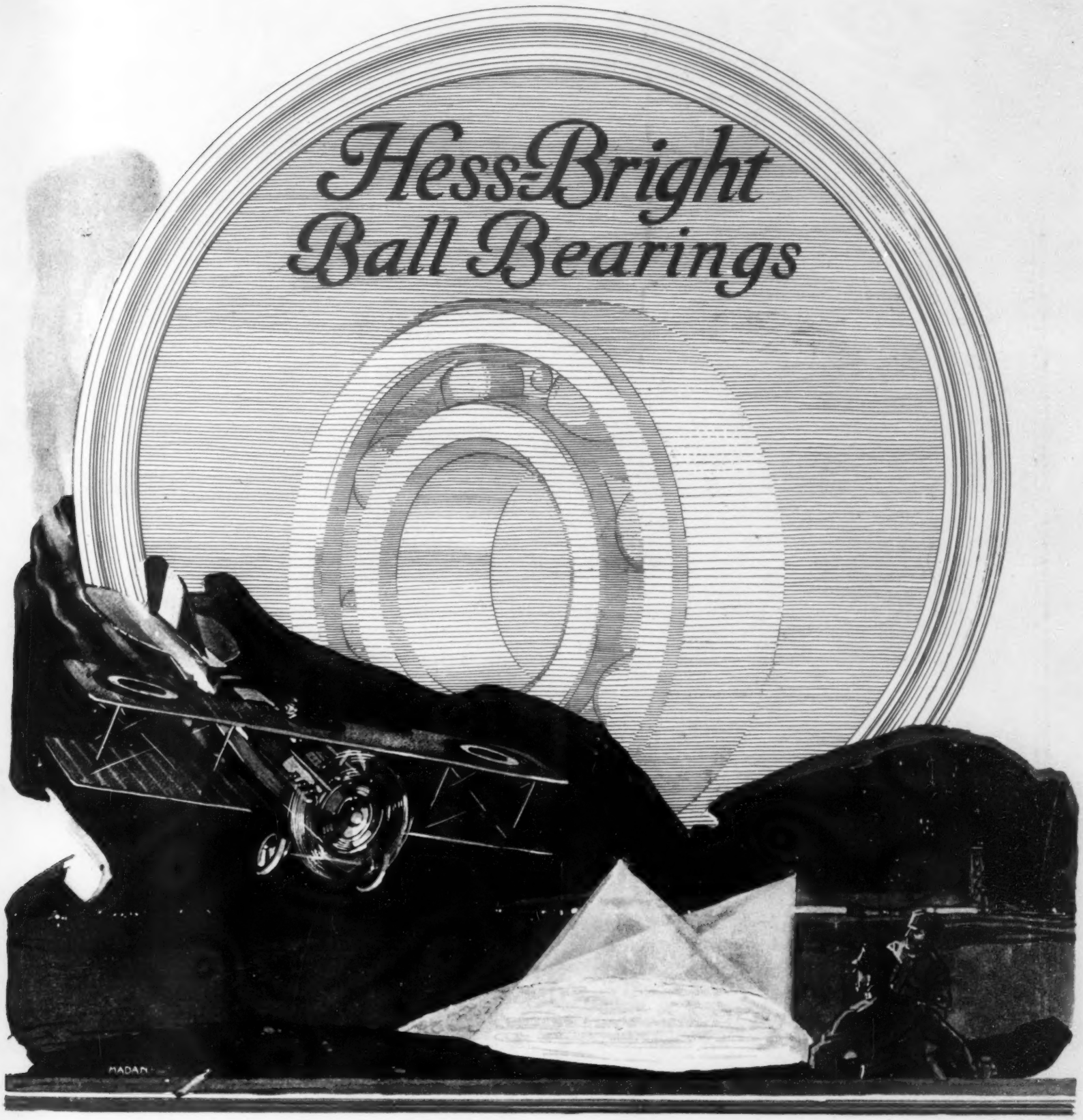
Soldering by the Schoop Process

THE Schoop metal-spraying process has been adapted to soldering. That process is generally carried out by hand with the help of simple tools, but it is slow and expensive. Specially constructed soldering machines are available, but seem mainly suitable for soldering repetition work, and for the canned-food industry. M. Schoop conceived the idea of a hand apparatus used with a wire solder which, melted under the heat of a jet, would simplify methods. His plan is to spray directly on the surface to be joined, and it is claimed that clean, economical, and rapid work results. The construction of the "soldering pistol" is simpler than that of the metallization pistol, as air pressure can be dispensed with, the soldering wire being applied with the help of the melting flame, which is under pressure. The wire is attached to a small driving mechanism which introduces it continuously into the melting flame.

Reindeer Meat to Relieve Food Shortage

REINDEER steaks may some day take the place of beef, if the meat shortage becomes very serious. Thousands of surplus male reindeer are to be had in Alasaka every year, and while small shipments have been made from time to time there has been no systematic exportation on a large scale.

Of the total of 98,582 reindeer now in Alaska Territory 67,448 are owned by 1,568 native Eskimos, and valued at $1,686,200. Reindeer meat is said to be as nourishing as beef, and it would contribute toward the conservation of live stock. There are no expenses attached to their maintenance beyond the labor of herding and cost of shelter and butchering.



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TORPEDO-MOTOR BOATS IN ACTION [See page 556]

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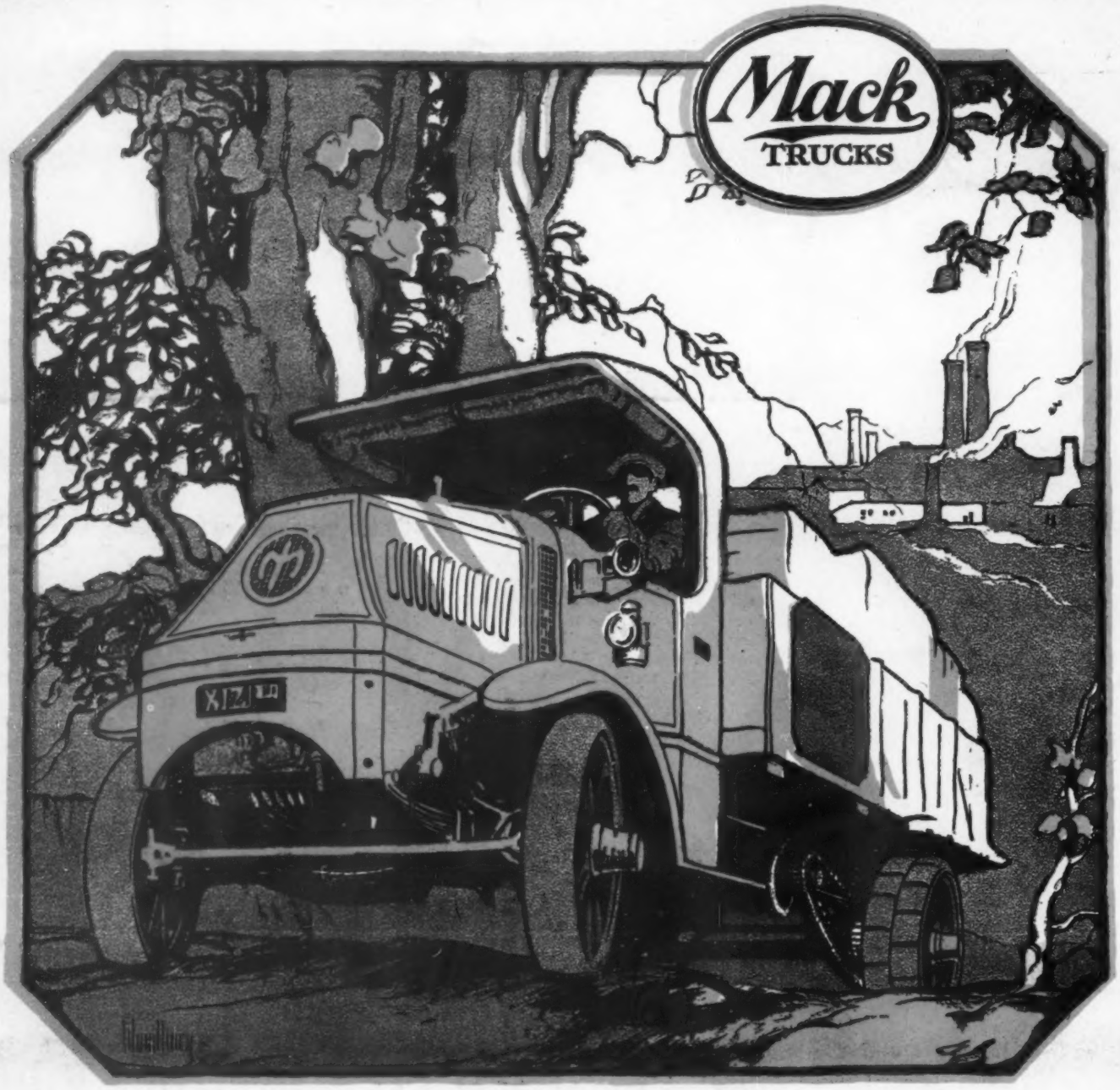

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